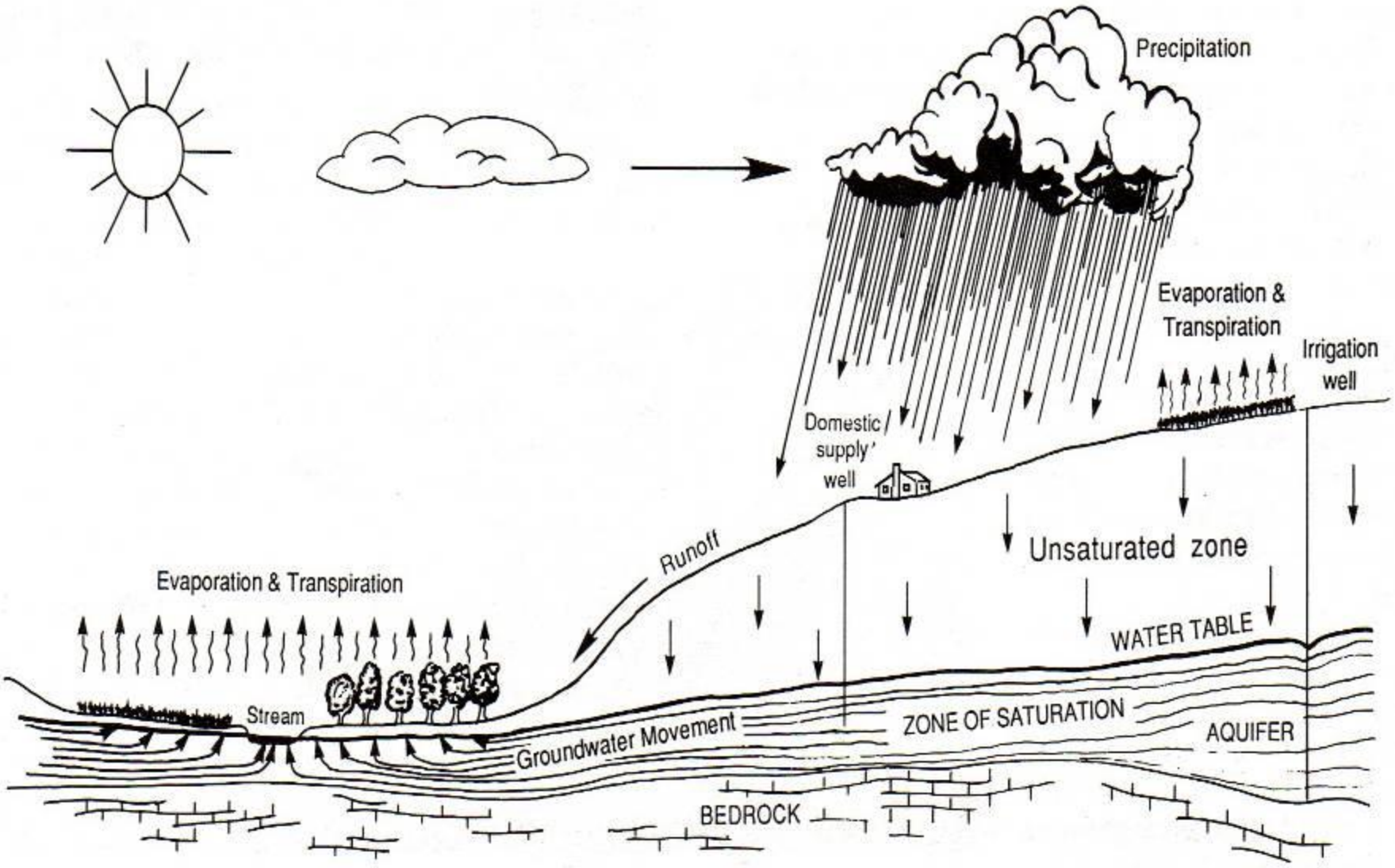
Water Basics

- **Jim Bendfeldt**
- **Jesse Bradley**
- **Mike Clements**
- **Mace Hack**
- **Geoff Ruth**
- **Dave Sands**
- **Stan Staab**
- **John Turnbull**

- **Assisted by:**
- **Melissa Hilty**
- **Dan Wiles**

Where does our water come from?


Precipitation
Evaporation &
Transpiration
Irrigation
well
Domestic
supply
well
Runoff
Unsaturated zone
Evaporation & Transpiration
WATER TABLE
Stream
Groundwater Movement
ZONE OF SATURATION
AQUIFER
BEDROCK

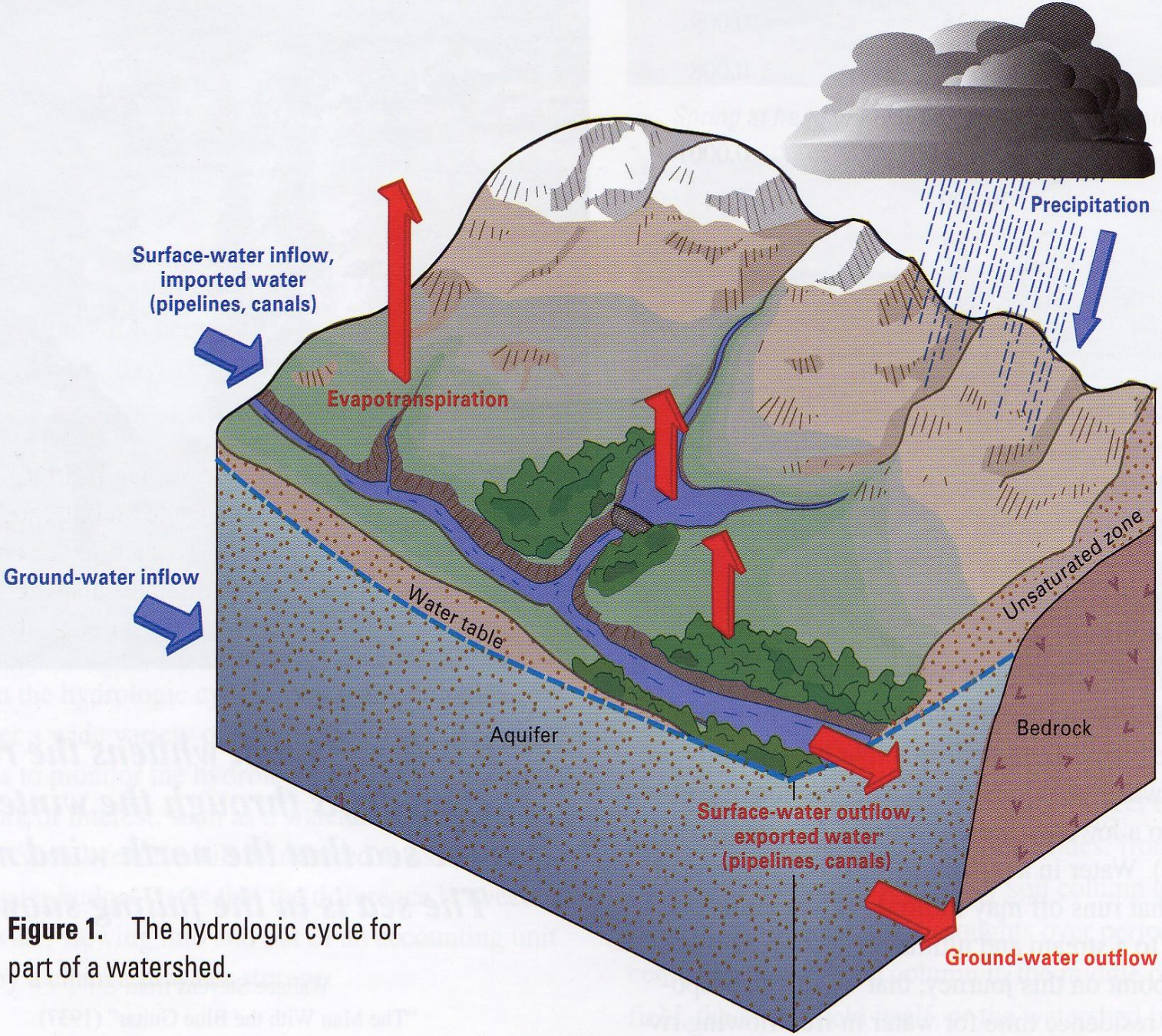


Figure 1. The hydrologic cycle for part of a watershed.

ESTIMATED
WATER USE IN NEBRASKA
1 9 9 5

Nebraska River Basins

April 1998

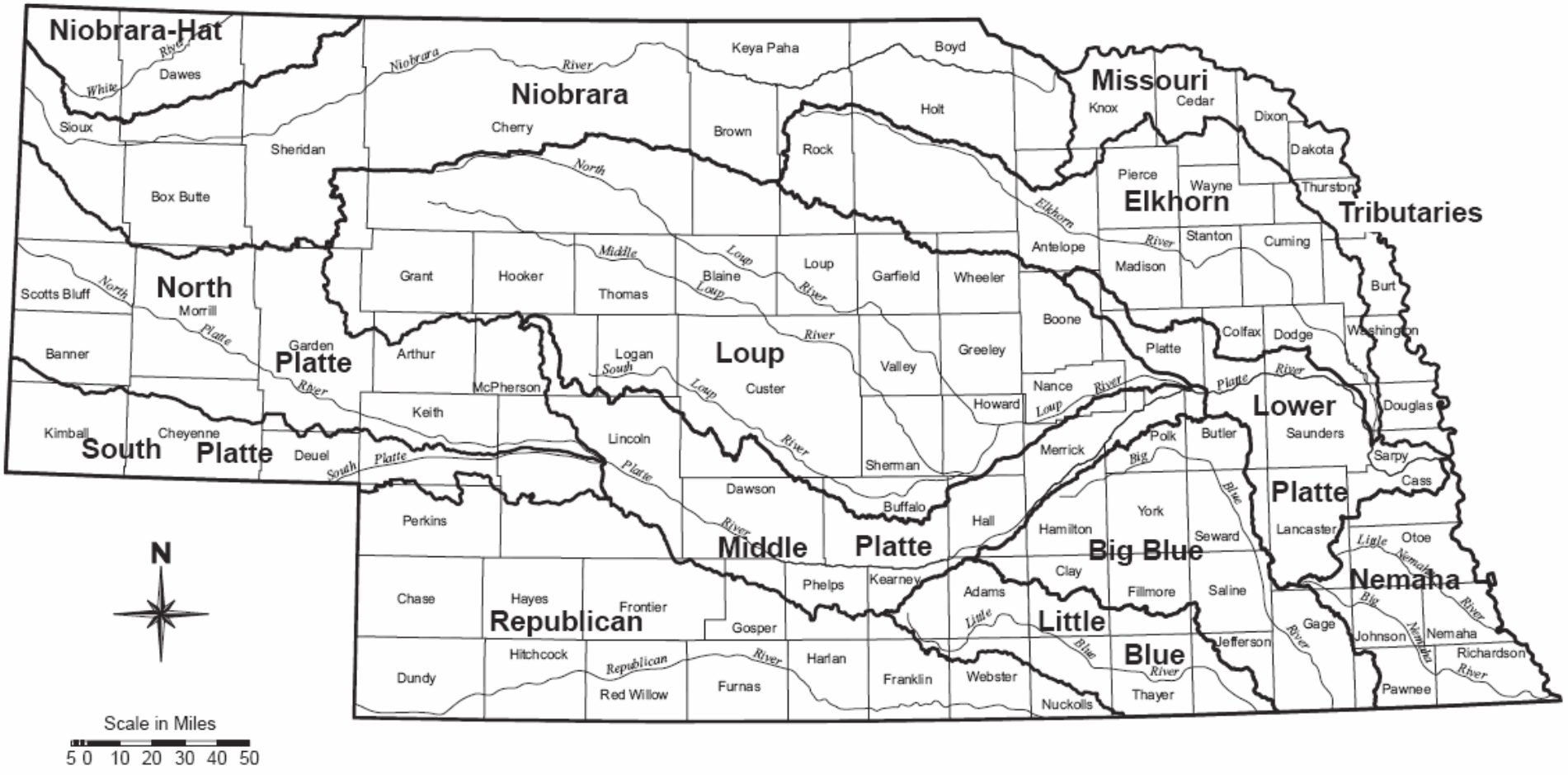
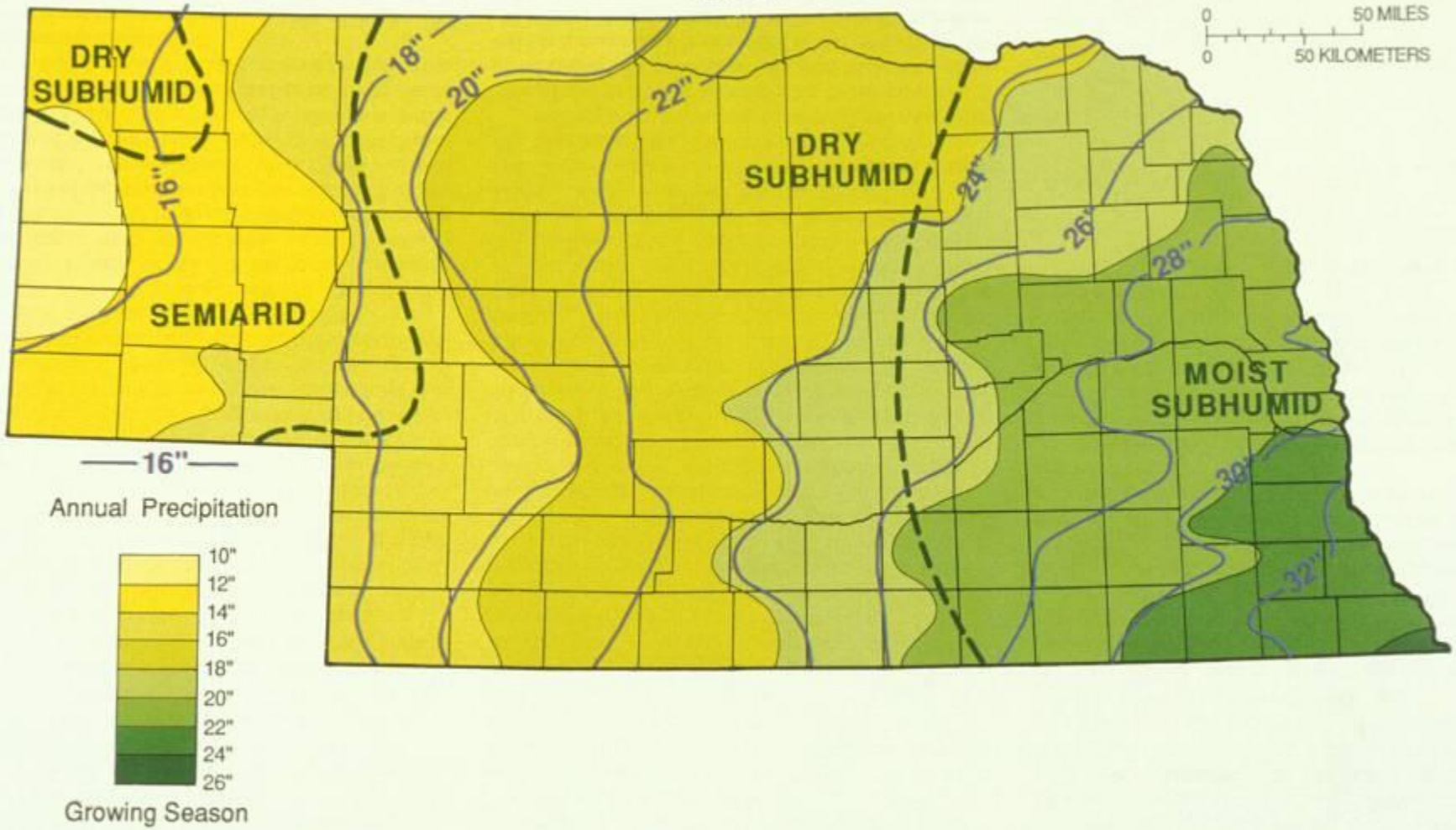


Figure 16



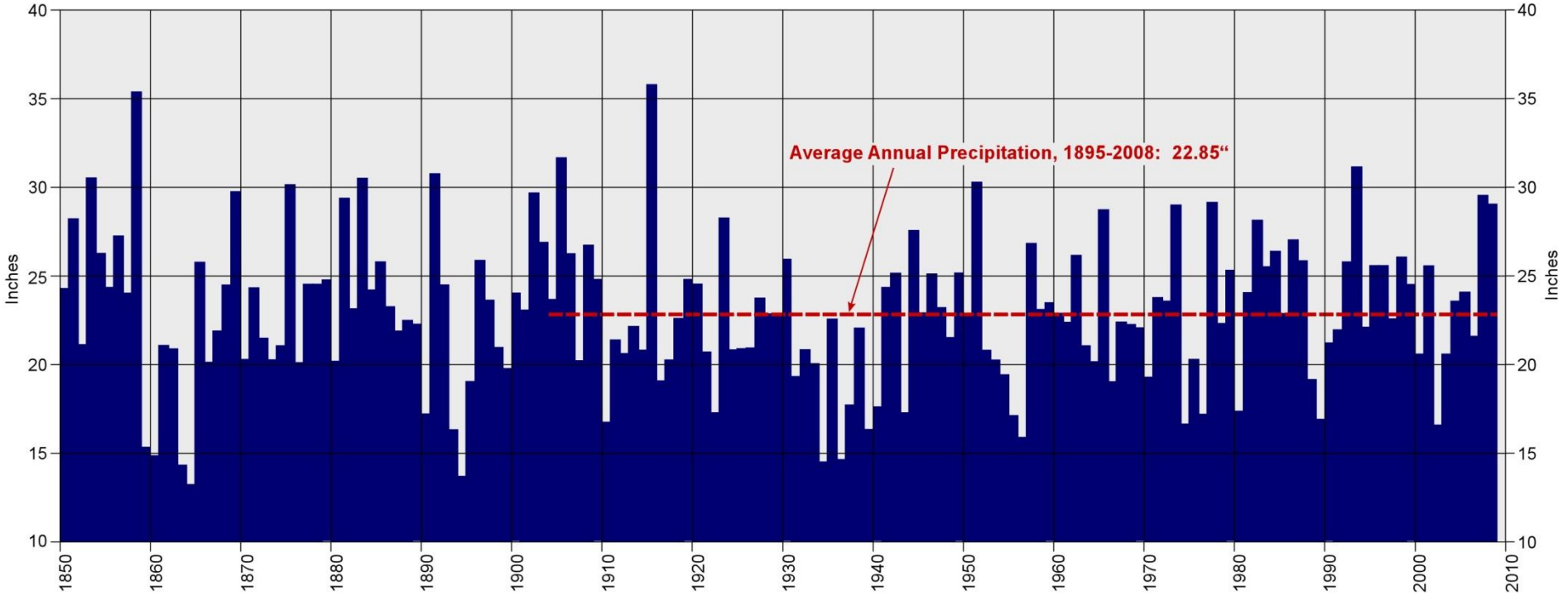
Average Annual and Average Growing Season Precipitation

Historical Trends in Groundwater Use (continued)

Center-pivot systems numbered 2,757 such systems

Current estimates from industry officials place

Average Annual Precipitation in Nebraska Showing Departures from 1895-2008

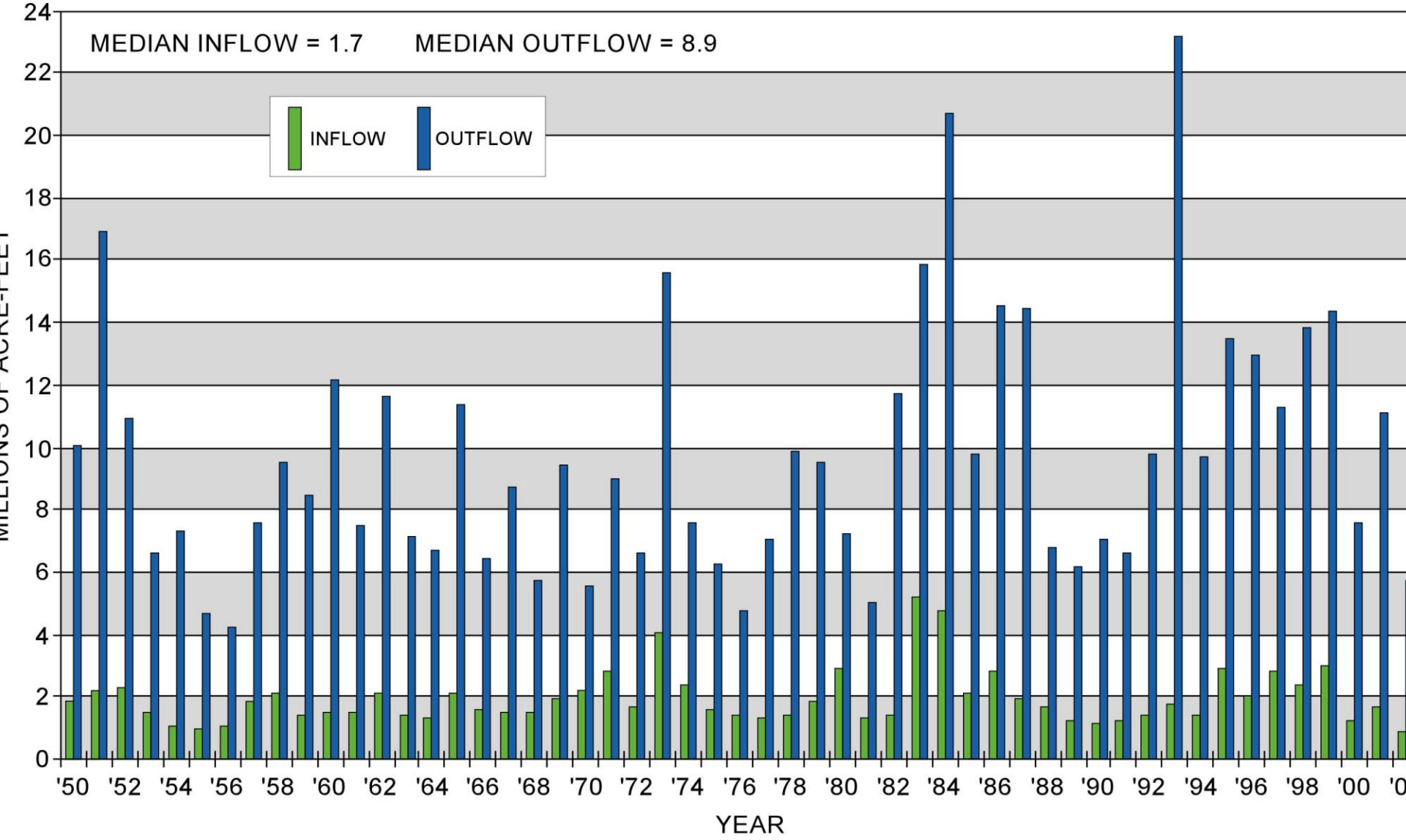


First Year	Last Year	Duration of Drought	Years Between Droughts
1220	1231	12	
1260	1272	13	29
1276	1313	38	3
1383	1388	6	33
1438	1455	18	16
1493	1498	6	38
1512	1529	18	13
1539	1564	26	10
1587	1605	19	23
1626	1630	5	20
1668	1675	8	38
1688	1707	20	13
1728	1732	5	21
1761	1773	13	29
1798	1803	6	26
1822	1832	11	25
1858	1866	9	25
1884	1895	12	18
1906	1913	8	10
1931	1940	10	17
1952	1957	6	11
Average		12.8	23.9

How much do we have?

University of Nebraska Lincoln
Pioneering new frontiers.

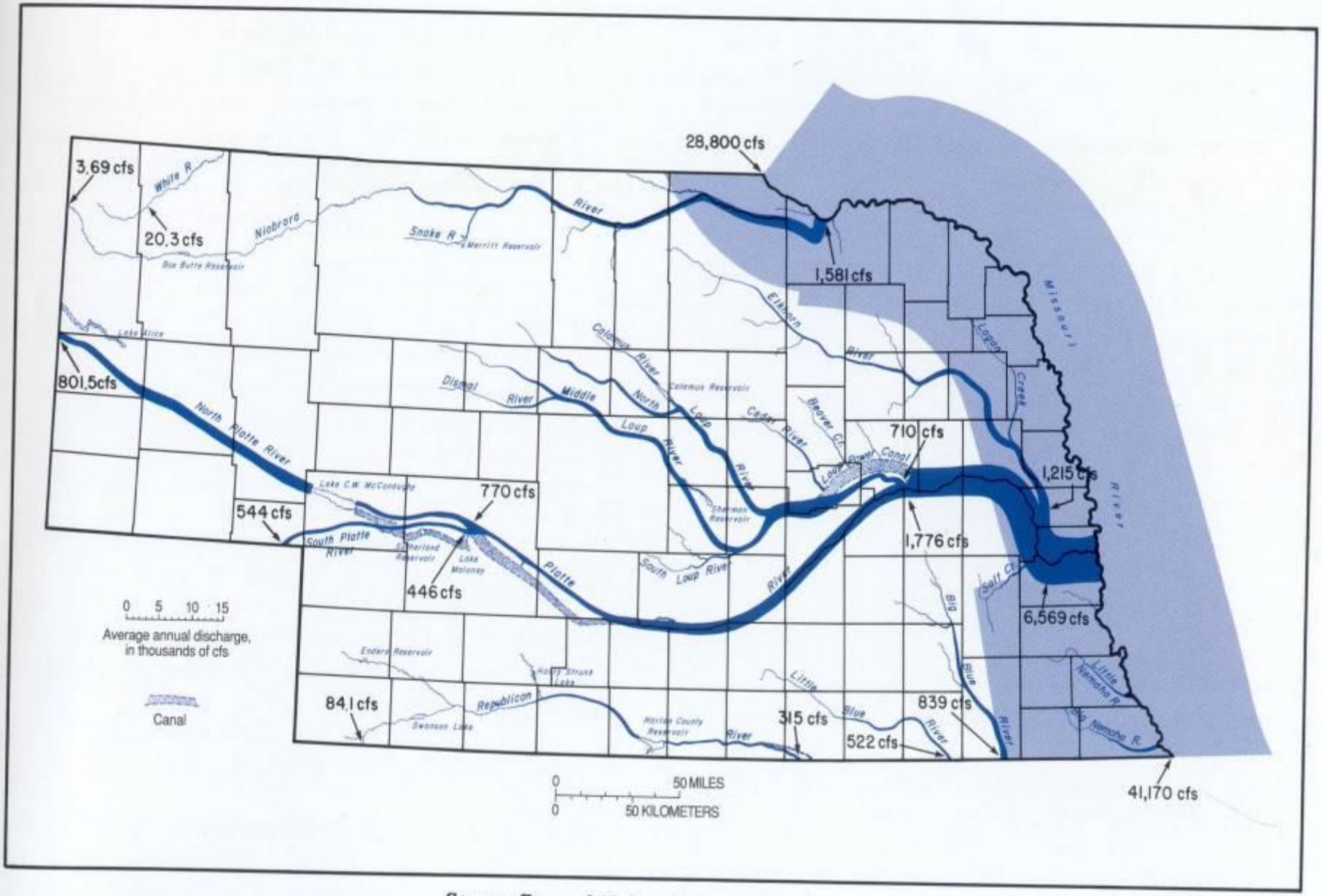
ANNUAL INFLOW OF WATER TO NEBRASKA AND ANNUAL OUTFLOW OF WATER FROM NEBRASKA 1950-2003



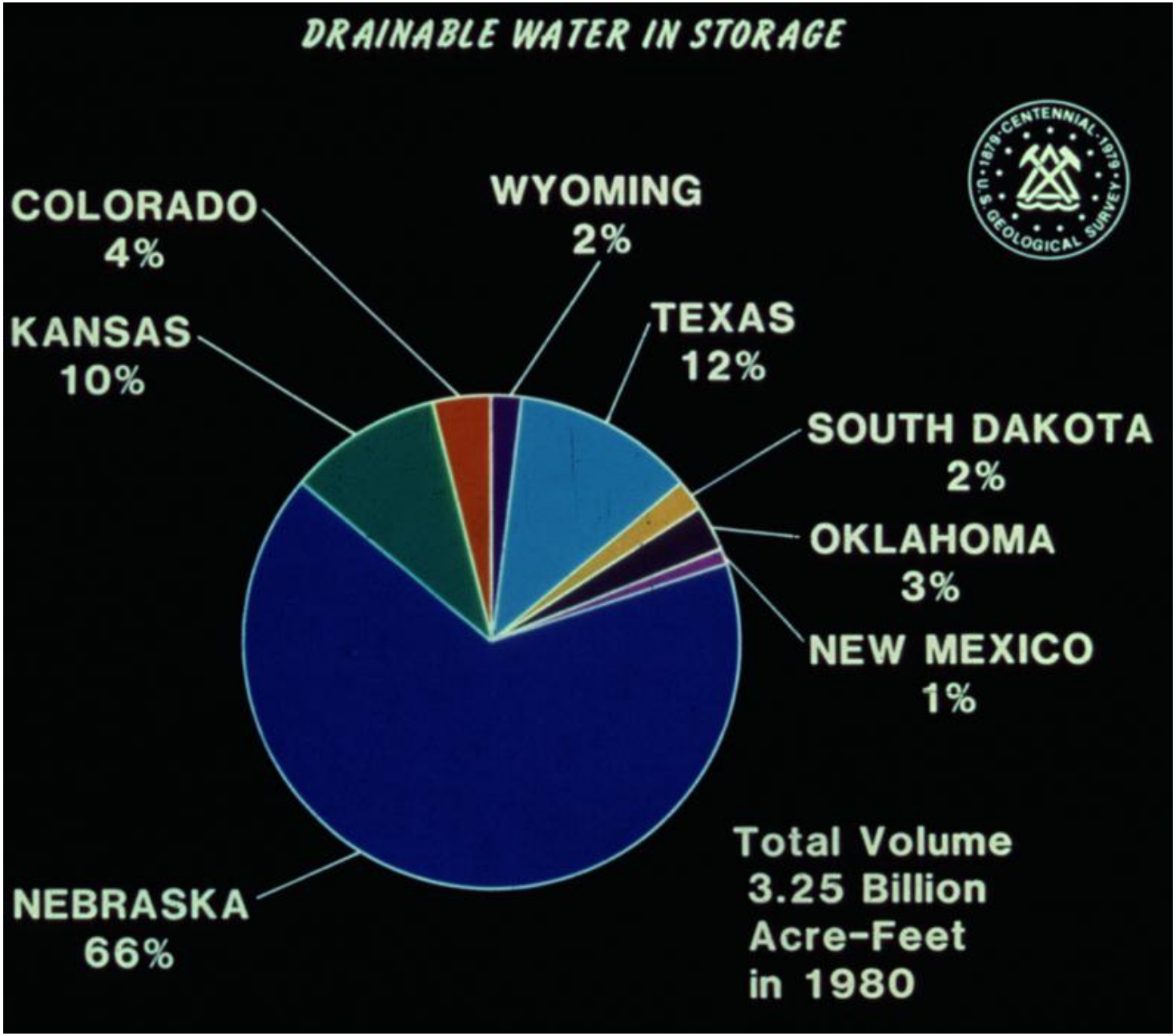
Prepared by:
Scott Summerside, Will Myers, and Susan Olafsen-Lackey
Conservation and Survey Division
School of Natural Resources

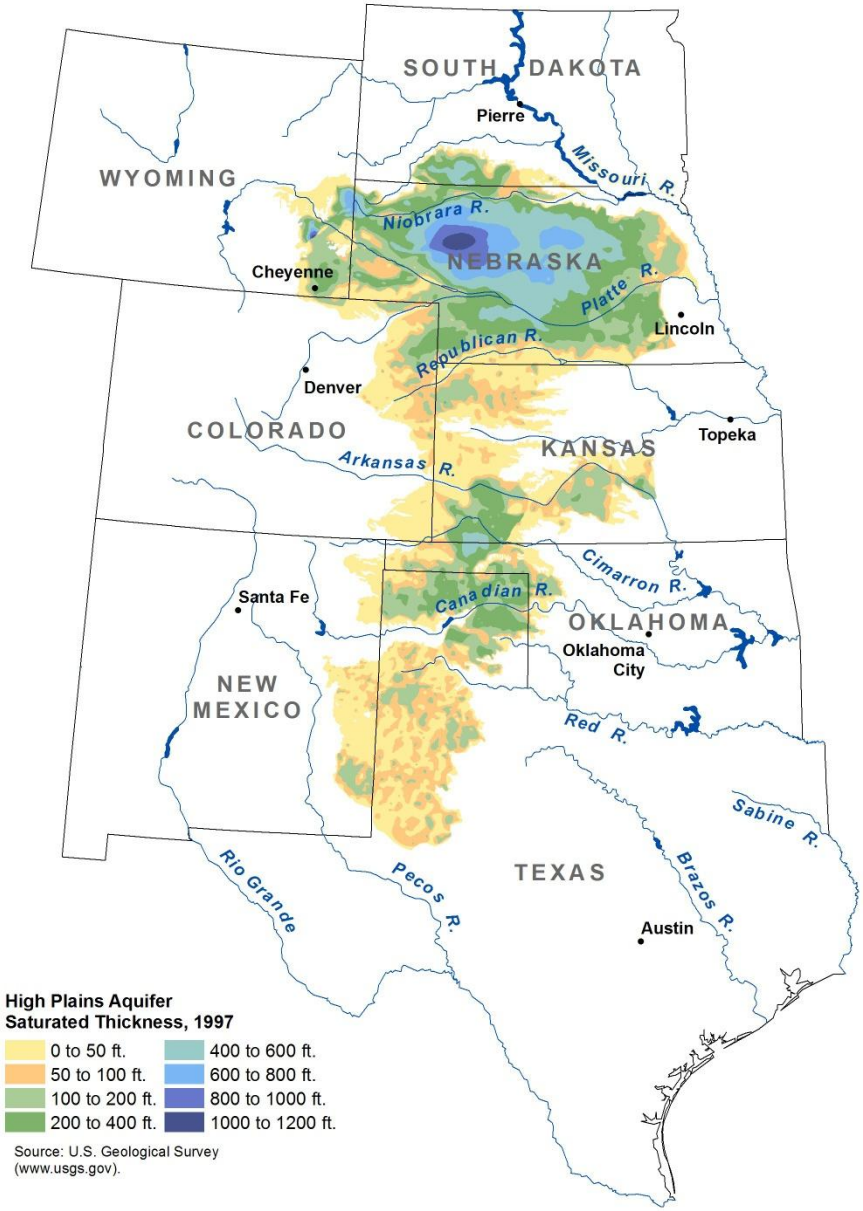
August 2005

Data sources:



Streamflow of Nebraska's major rivers

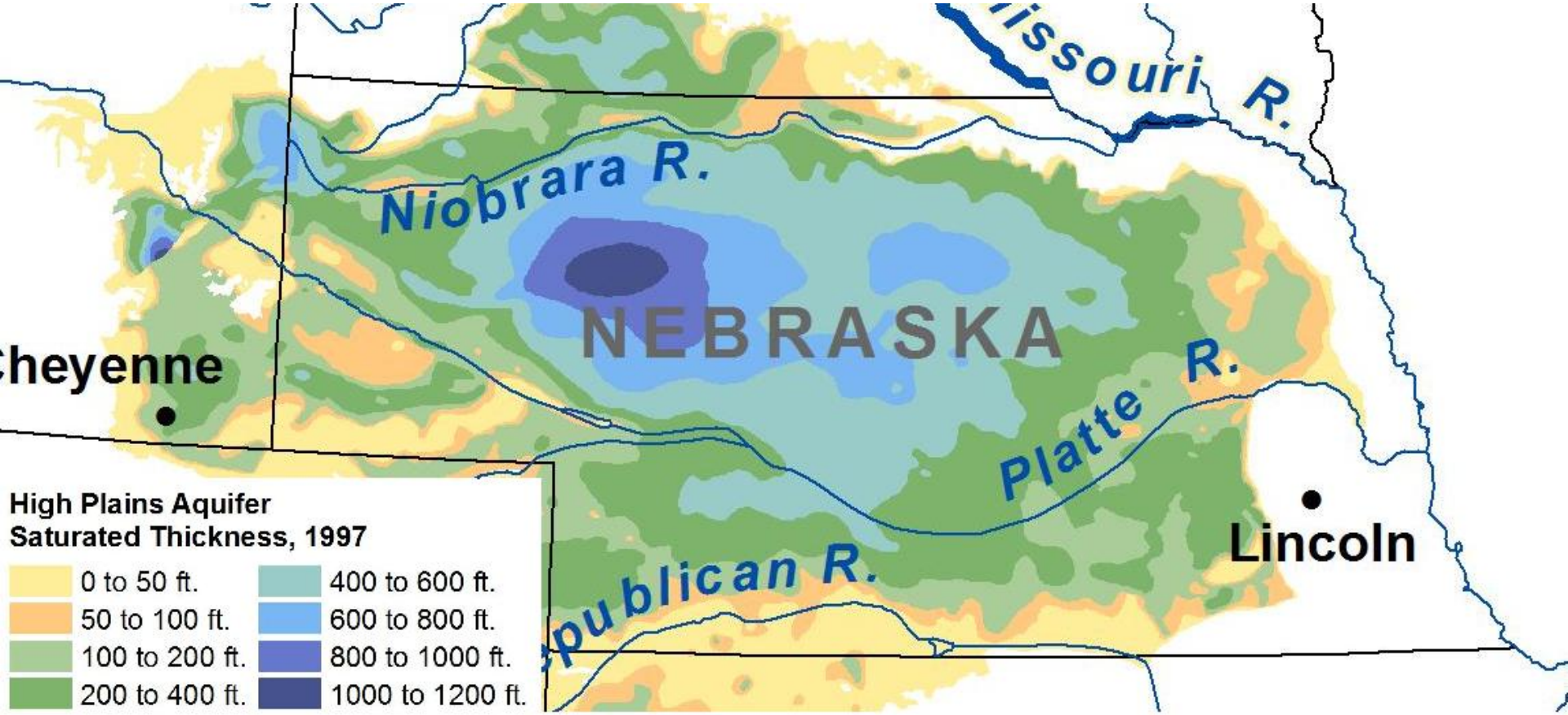

DRAINABLE WATER IN STORAGE
U.S. GEOLOGICAL SURVEY • 1879-CENTENNIAL-1979 •
COLORADO
4%
WYOMING
2%
TEXAS
12%
KANSAS
10%
SOUTH DAKOTA
2%
OKLAHOMA
3%
NEW MEXICO
1%
NEBRASKA
66%
Total Volume
3.25 Billion
Acre-Feet
in 1980



University of Nebraska Lincoln

This map was produced by the University of Nebraska-Lincoln. For additional information and an interactive version of this map visit http:// water.unl.edu

The information presented on this map is the best available as of July 2008. To order a copy of this map go to nebraskamaps.unl.edu. Any questions or comments

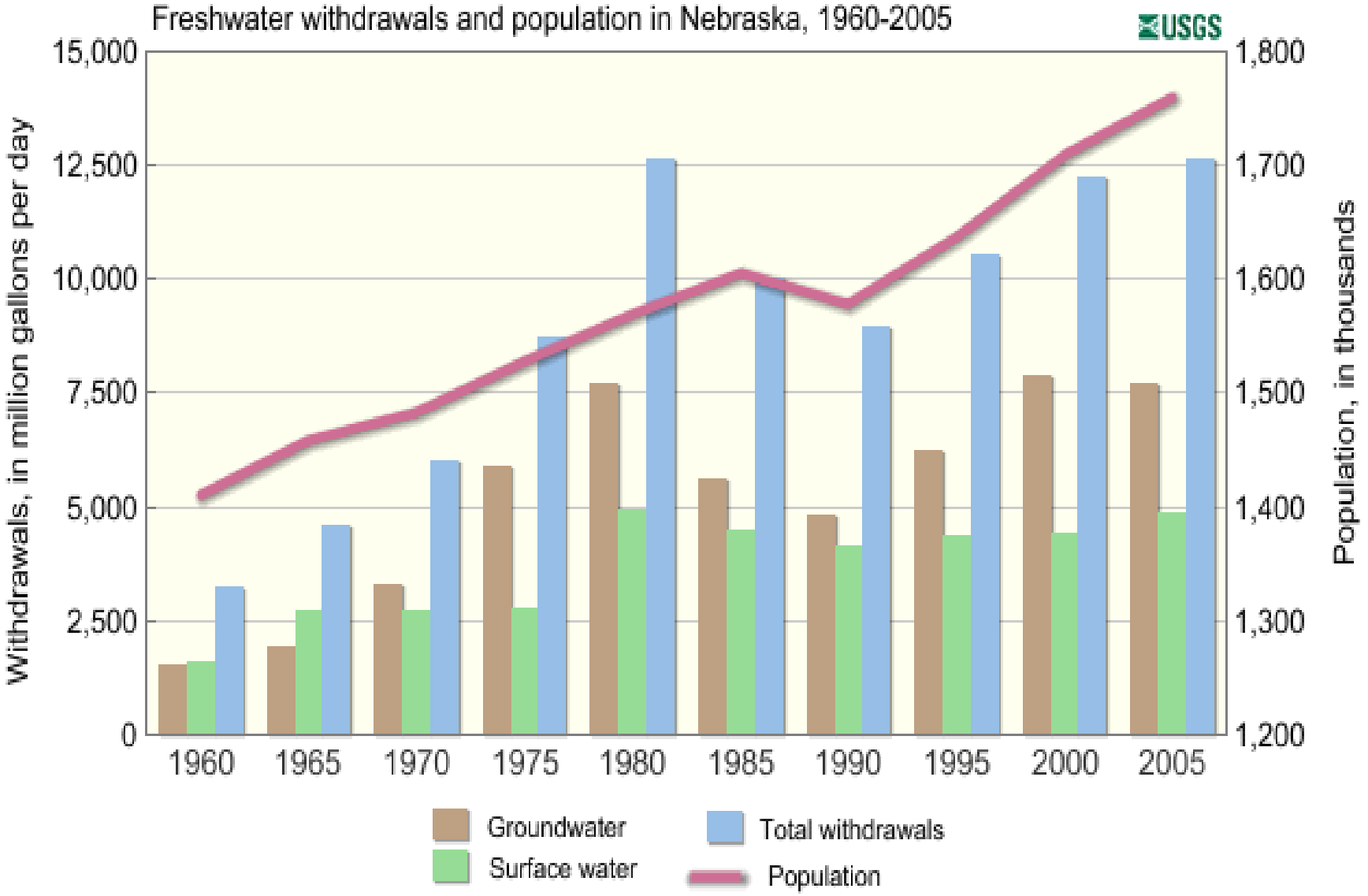


Source: U.S. Geological Survey (www.usgs.gov).

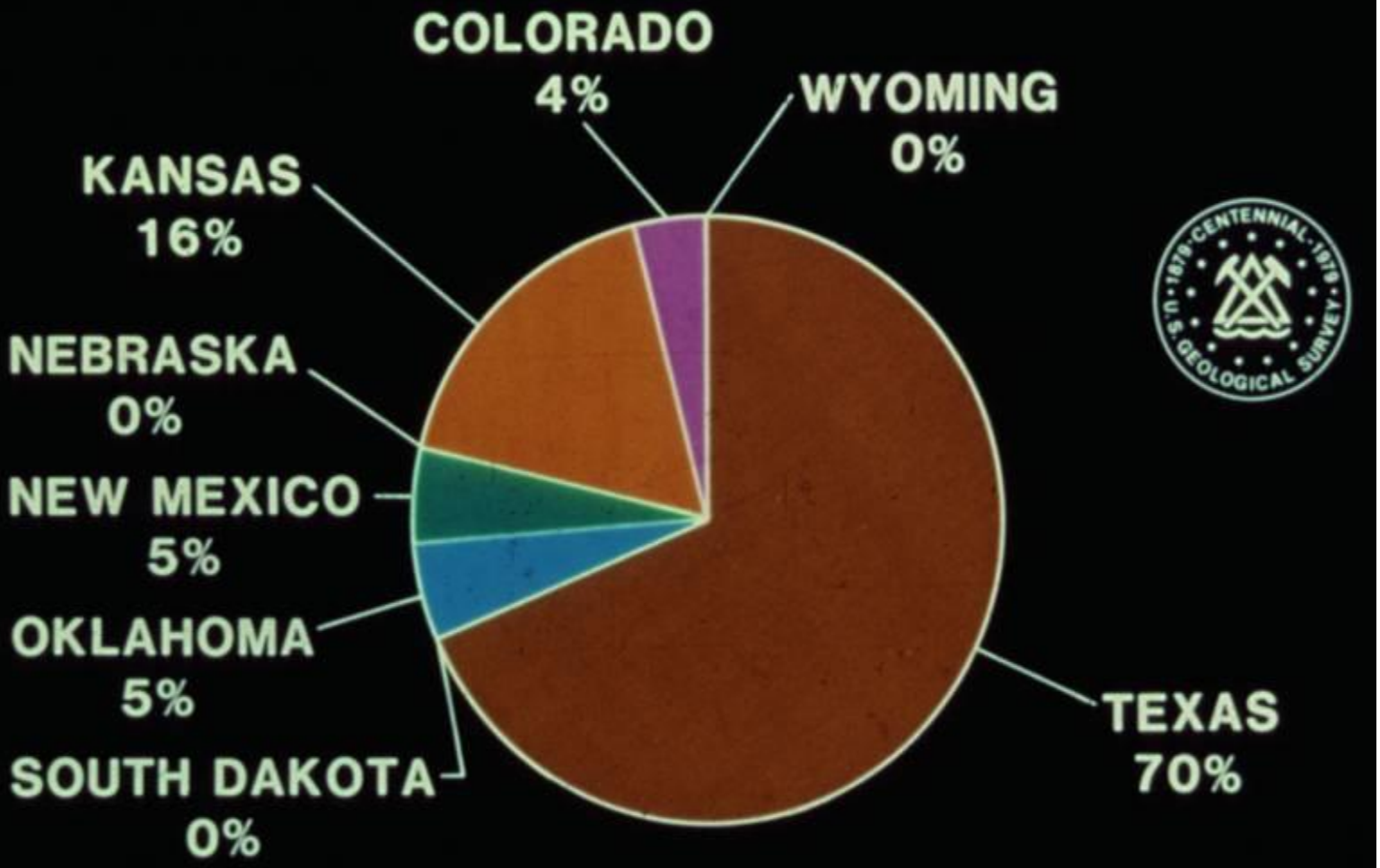
University of Nebraska Lincoln

The information presented on this map is the best available as of July 2008. To order a copy of this map go to nebraskamaps.unl.edu. Any questions or comments

How much do we use?


Freshwater withdrawals and population in Nebraska, 1960-2005
USGS
Withdrawals, in million gallons per day
Population, in thousands
15,000
12,500
10,000
7,500
5,000
2,500
0
1,800
1,700
1,600
1,500
1,400
1,300
1,200
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Groundwater
Surface water
Total withdrawals
Population

GROUND-WATER DEPLETION



Total Depletion
166 Million Acre-Feet
Predevelopment to
1980

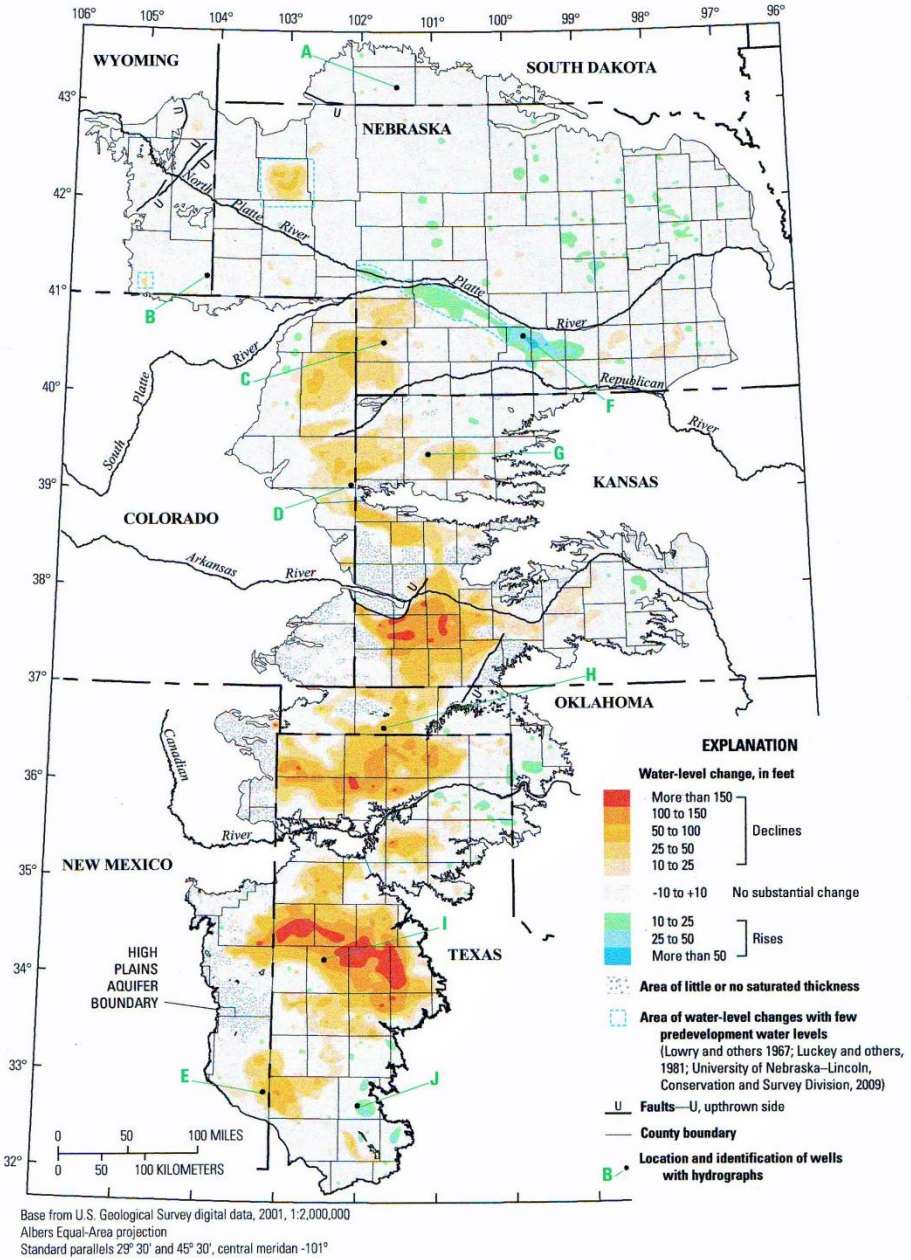
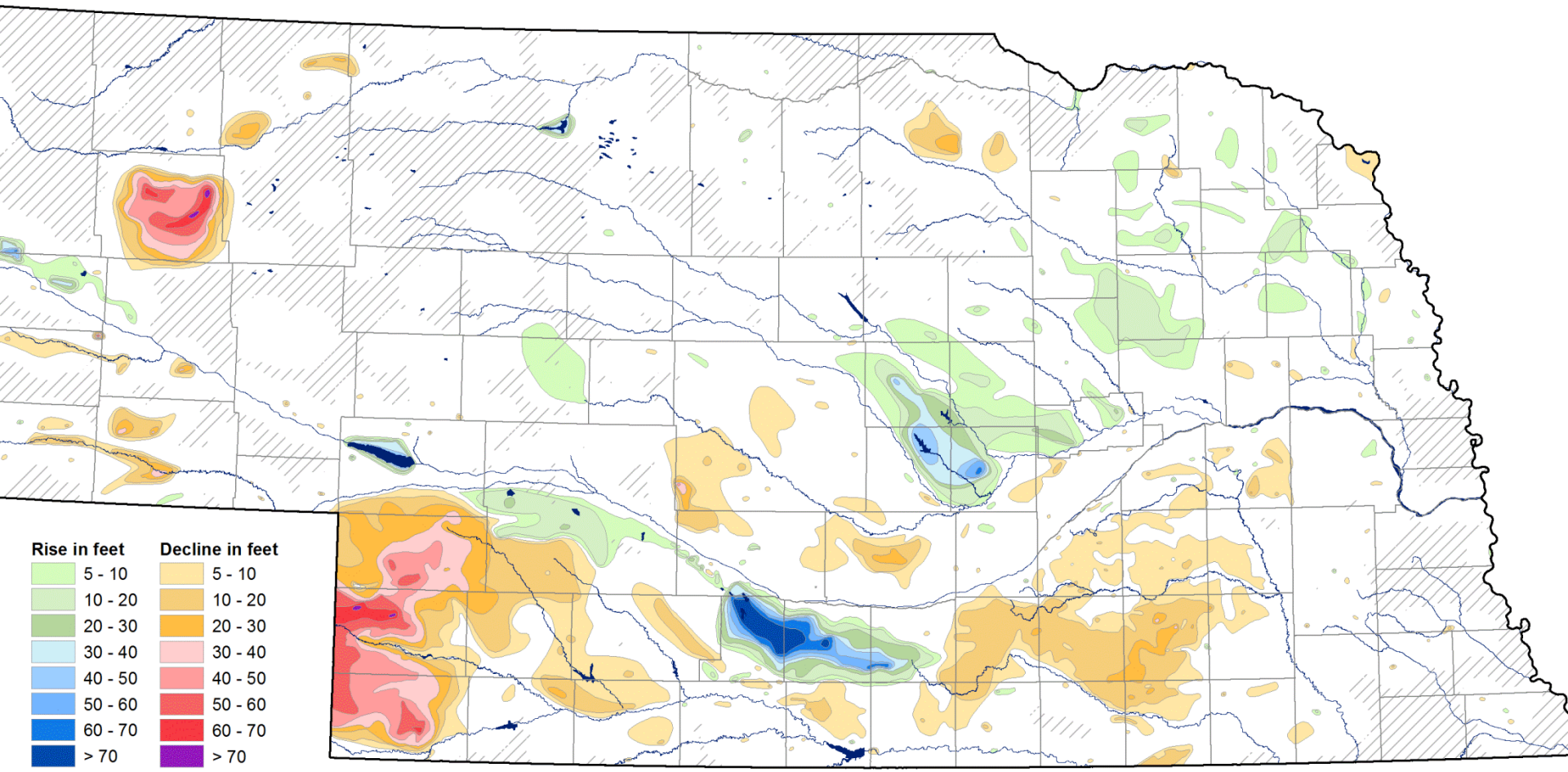


Figure 2. Water-level changes in the High Plains aquifer, predevelopment to 2009 (modified from Gutentag and others, 1984).

Groundwater-level Changes in Nebraska - Predevelopment to Spring 2010



CONSERVATION AND SURVEY DIVISION (http://snr.unl.edu/csd)
School of Natural Resources (http://snr.unl.edu)
Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln

Jesse Korus, Groundwater Resources Coordinator, CSD
Mark Burbach, Water Levels Program Supervisor, CSD
Les Howard, GIS Manager, CSD

U.S. Geological Survey
Nebraska Water Science Center

U.S. Bureau of Reclamation
Kansas-Nebraska Area Office

Nebraska Natural Resources Districts

Central Nebraska Public Power and Irrigation Dis

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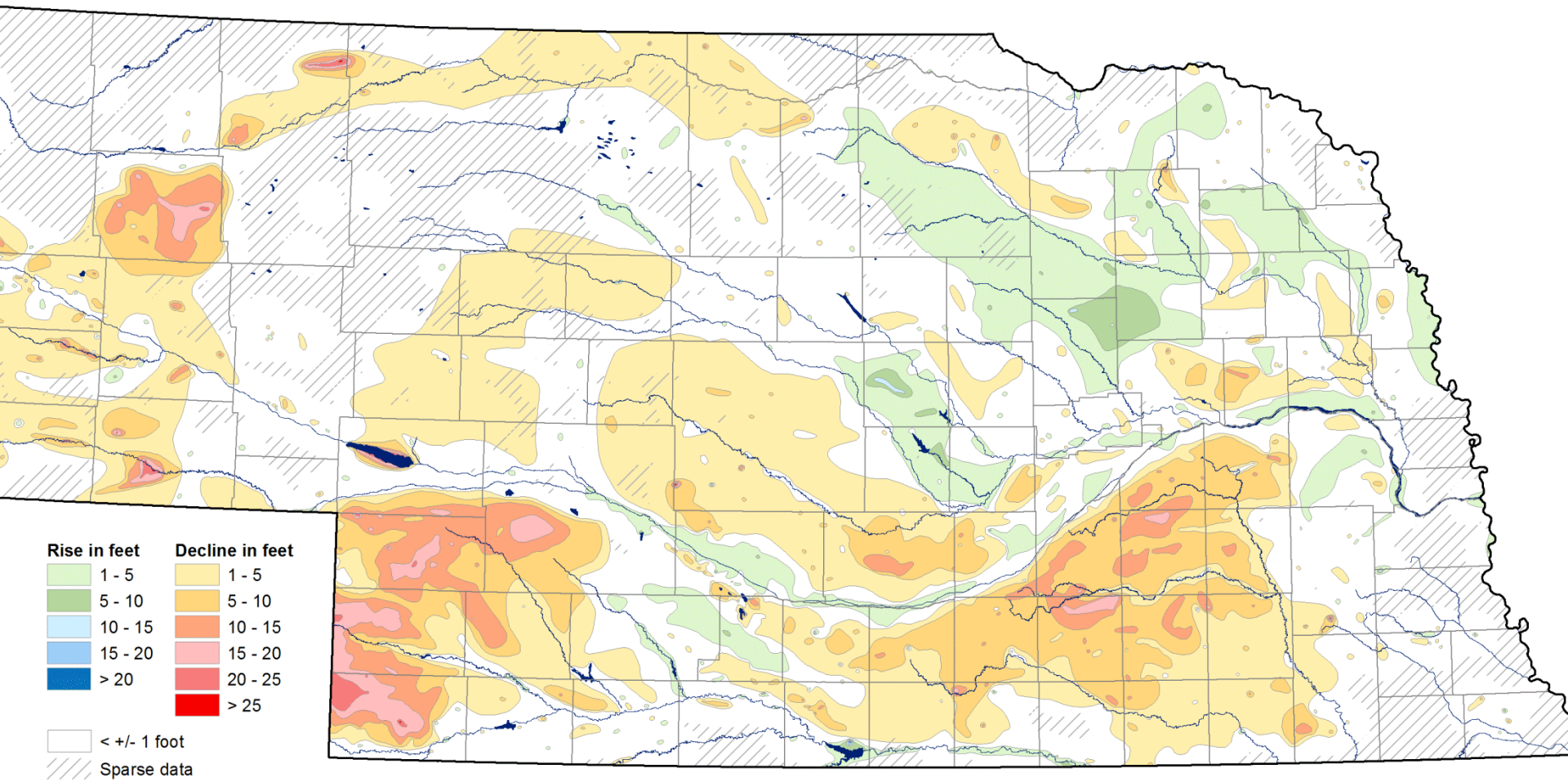
Institute of Agriculture and Natural Resources
University of Nebraska–Lincoln

December 20

Groundwater-level Changes in Nebraska - Spring 2000 to Spring 2010



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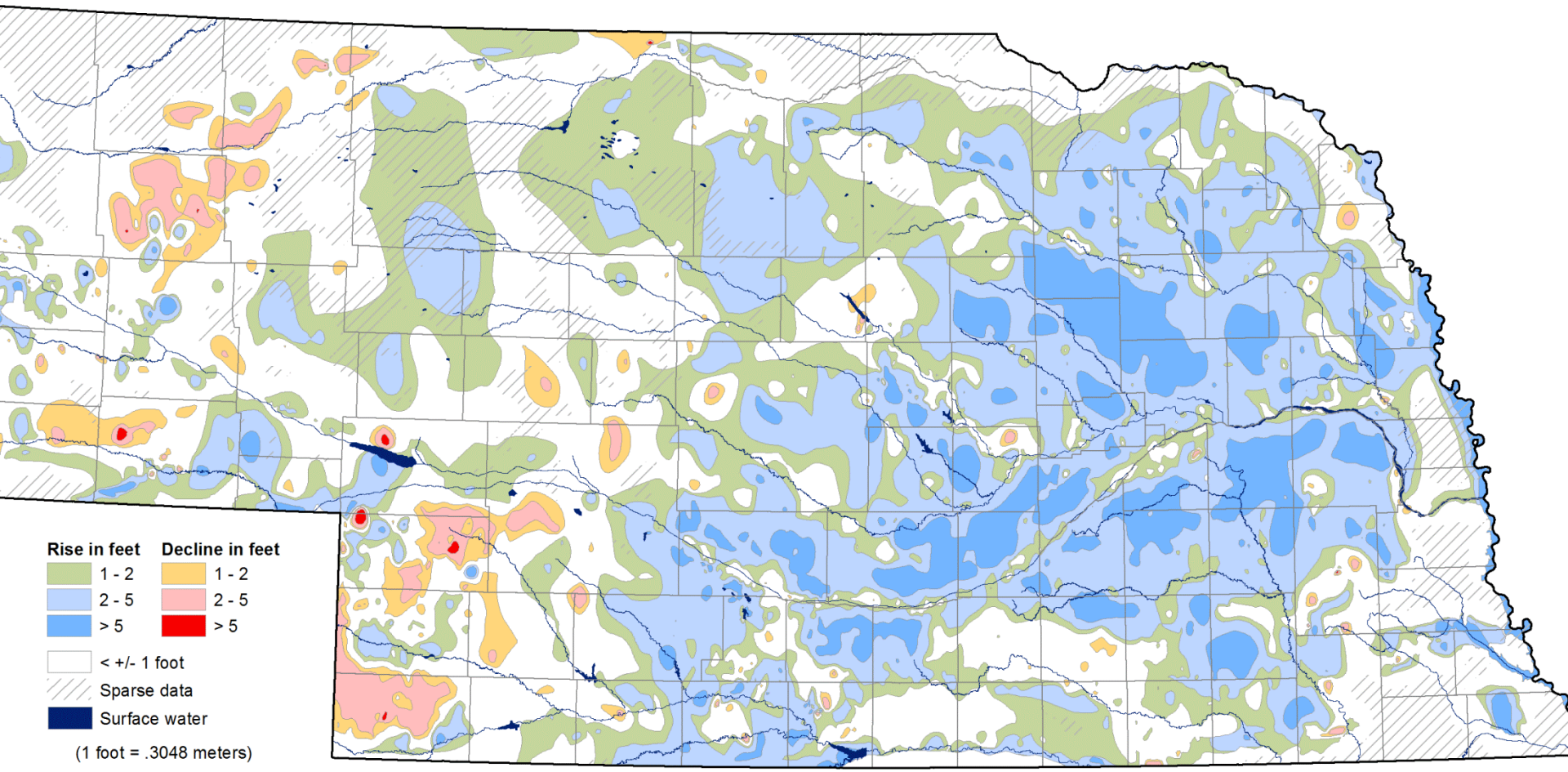
December 20

Groundwater-level Changes in Nebraska - Spring 2007 to Spring 2010



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Matt Joeckel, Research Geologist, CSD

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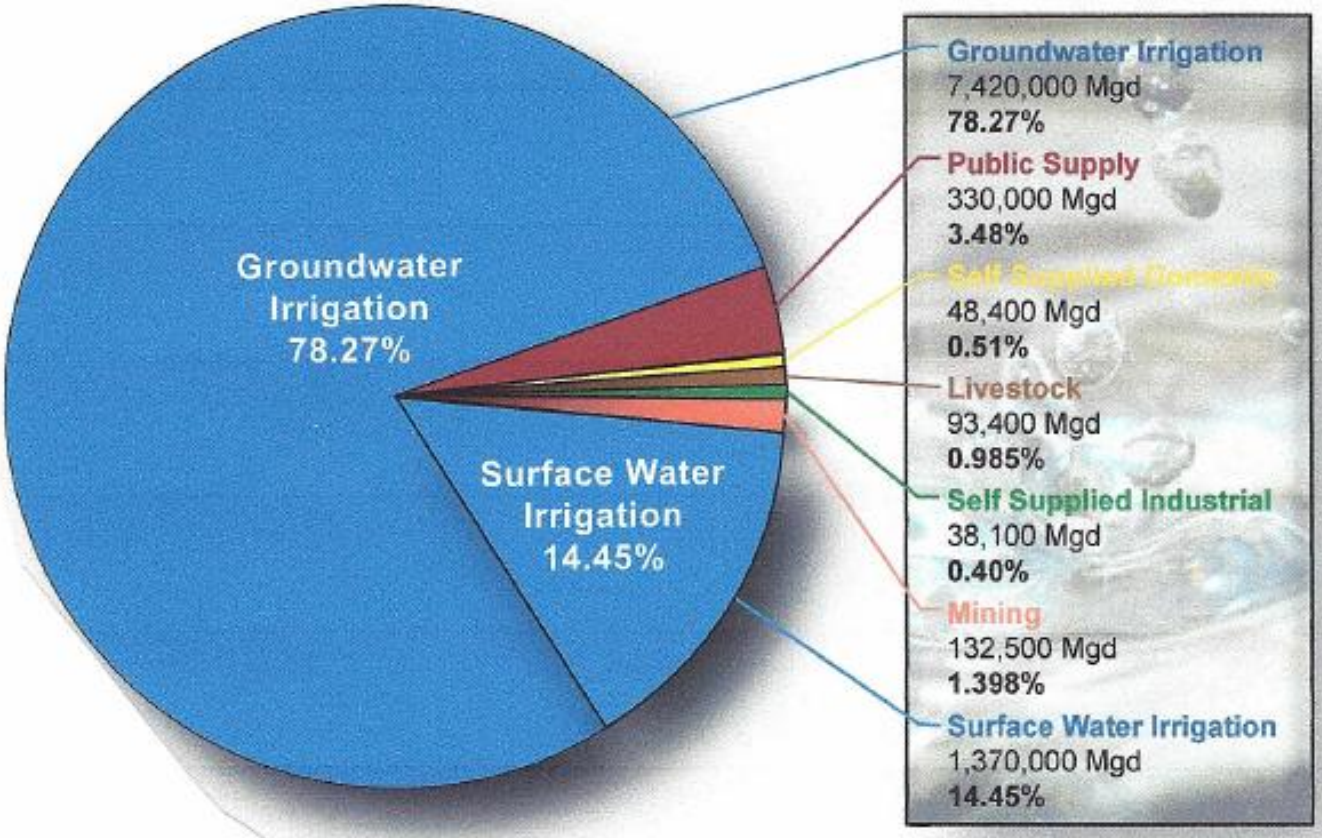
December 20

What do we use it for?

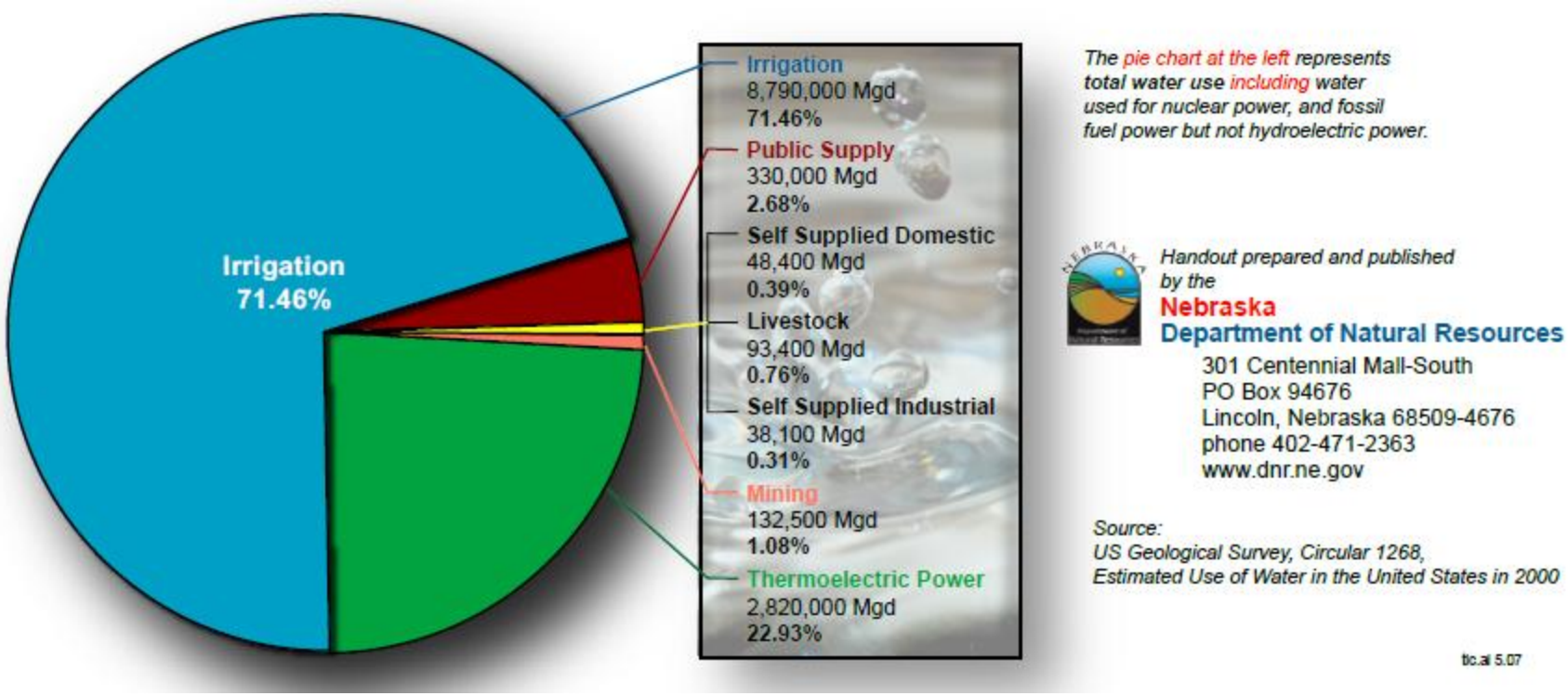
Estimated
Total Water Withdrawals
by water use category for the year 2000



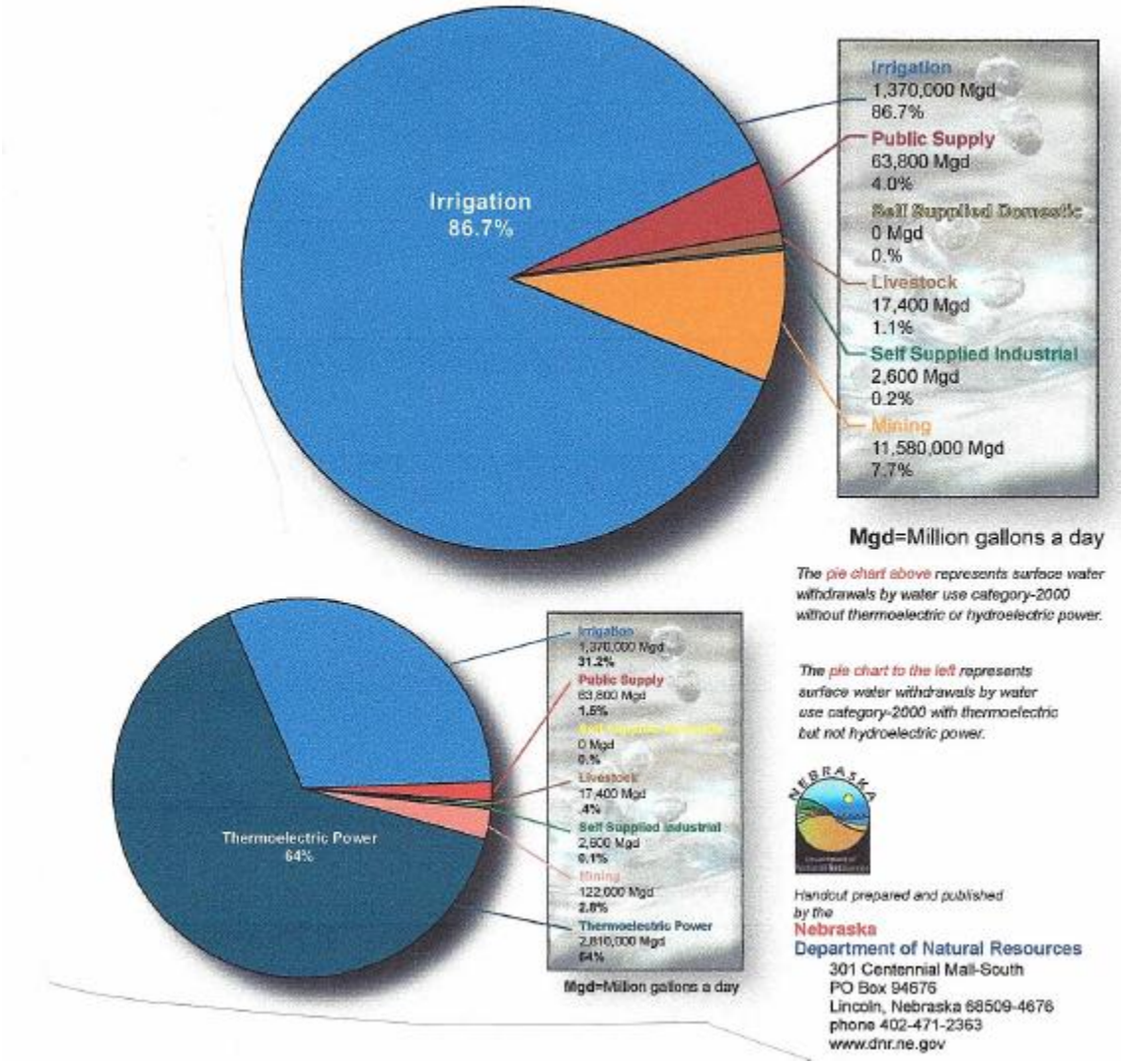
Mgd=Million gallons a day

The pie chart above represents total water use omitting water used for hydroelectric power, nuclear power, and fossil fuel power. Most of this amount was released back into the streams and rivers it was removed from for power generation and cooling purposes.

Total Water Use Including Power Production



Estimated
Total Surface Water Withdrawals
by water use category for the year 2000



Handout prepared and published by the
Nebraska
Department of Natural Resources
301 Centennial Mall-South
PO Box 94676
Lincoln, Nebraska 68509-4676
phone 402-471-2363
www.dnr.ne.gov

Estimated

Total Groundwater Withdrawals

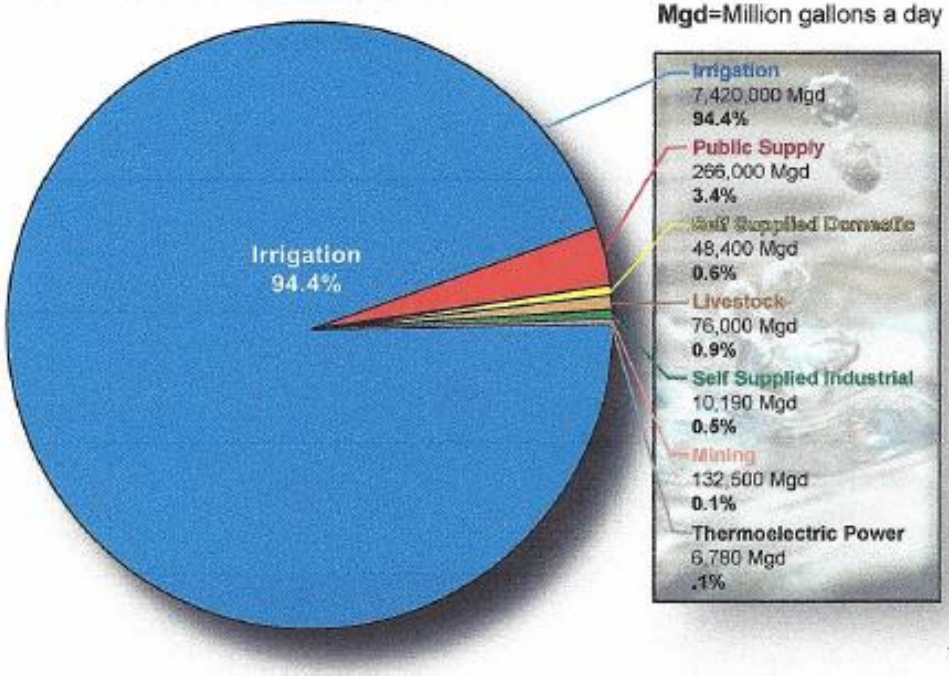
by water use category for the year 2000

WATER EQUIVALENTS TABLE

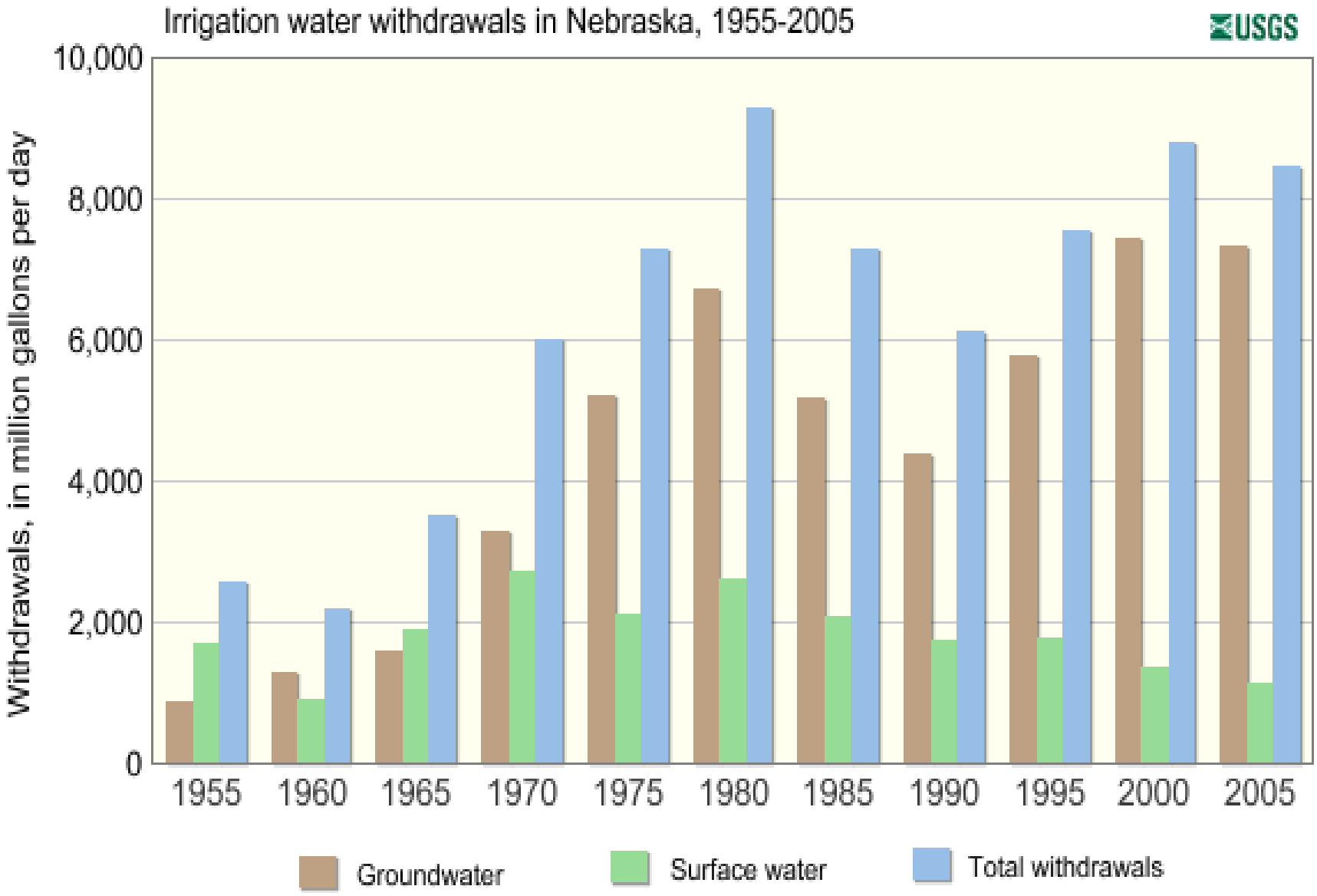
1 Cubic foot	7.48 gallons, 62.4 lbs. of water
1 Acre-foot	43,560 cubic feet, 325,851 gallons
An acre-foot of water covers 1 acre of land 1 foot deep	
1 cubic foot per second (cfs)	448.8 gallons per minute
1 cfs	646,272 gallons per day
For 24 hours	1.984 acre-feet
For 30 days	59.5 acre-feet
For 1 year	724 acre-feet
1 million gallons	3.07 acre-feet
1 million gallons per day (mgd)	1,121 acre feet per year
1,000 gallons per minute (gpm)	2.23 cfs
1,000 gpm	4.42 acre-feet per day
$.10 per 1,000 gallons	$32.59 per acre-foot
An acre-foot supplies a family of 5 for 1 year	
An acre-foot irrigates ½ acre of corn in most areas of Nebraska	

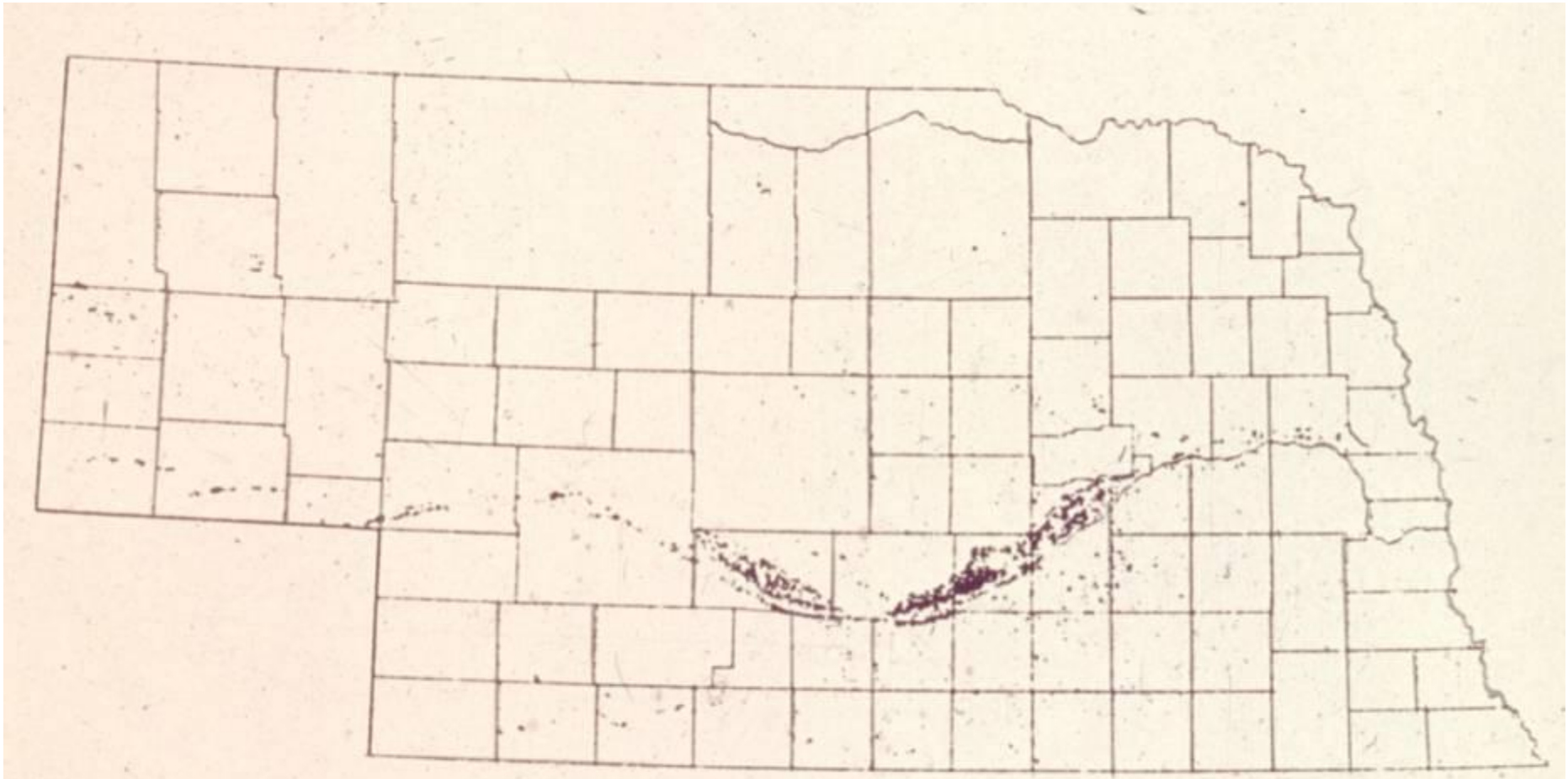
Source:
US Geological Survey, Circular 1268,
Estimated Use of Water in the United States in 2000

Mgd=Million gallons a day



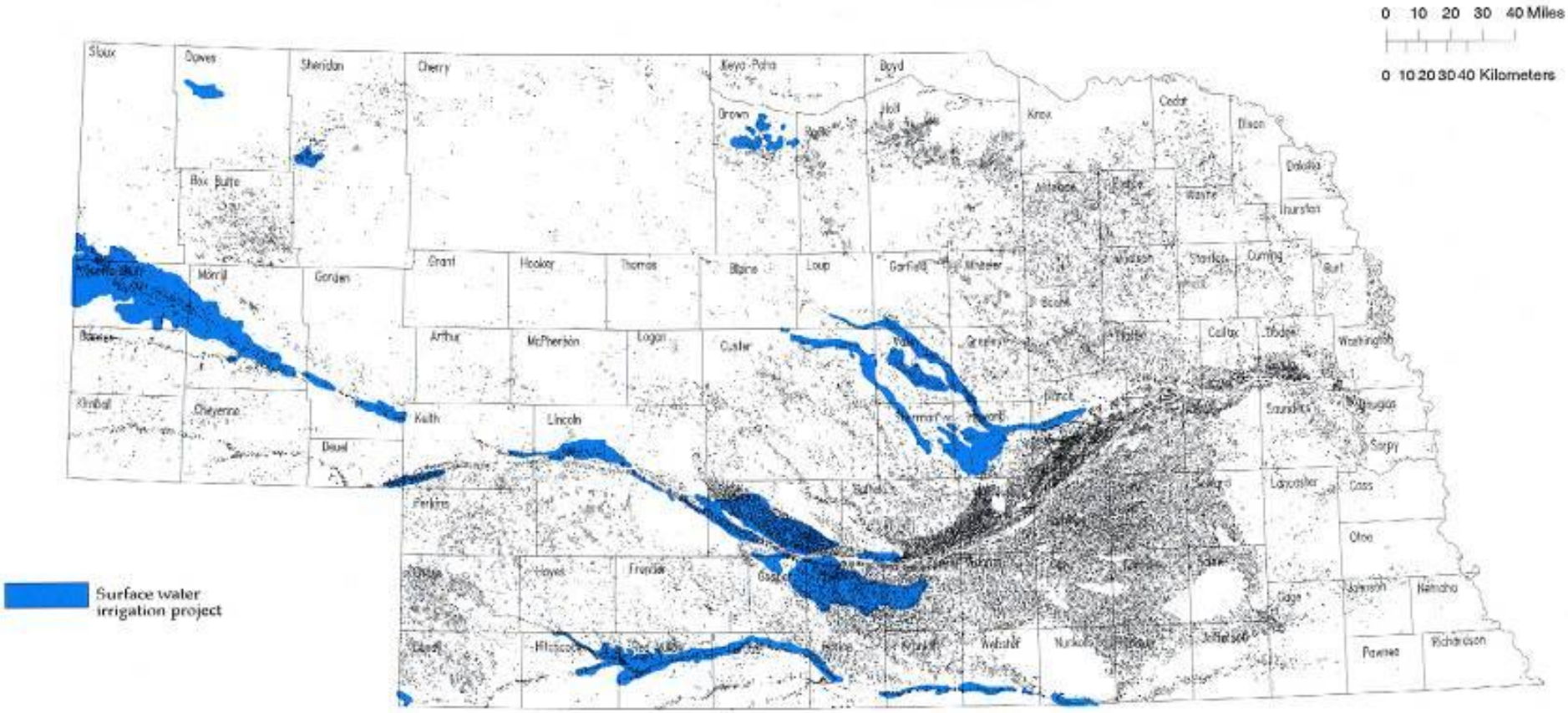
tlc al 5.07


Irrigation water withdrawals in Nebraska, 1955-2005
USGS
Withdrawals, in million gallons per day
10,000
8,000
6,000
4,000
2,000
0
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Groundwater
Surface water
Total withdrawals



Location of Irrigation Wells, 1951

Figure 15


0 10 20 30 40 Miles
0 10 20 30 40 Kilometers
Surface water irrigation project
Sioux
Dawes
Sheridan
Cherry
Keya Paha
Boyd
Brown
Box Butte
Morrill
Garden
Grant
Hooker
Thomas
Blaine
Loup
Garfield
Wheeler
Arthur
McPherson
Logan
Custer
Kimball
Cheyenne
Deuel
Keith
Lincoln
Perkins
Hayes
Frontier
Gosper
Knox
Cedar
Dixon
Dakota
Wayne
Thurston
Antelope
Pierce
Madison
Stanton
Cuming
Burt
Boone
Platte
Colfax
Dodge
Washington
Saunders
Douglas
Sarpy
Lancaster
Cass
Otoe
Johnson
Nemaha
Gage
Jefferson
Richardson
Pawnee
Nuckolls
Webster
Phelps
Kearney
Furnas
Harlan
Hitchcock
Red Willow

Nebraska Department of Natural Resources

Location Map

State of Nebraska
NRD Boundary

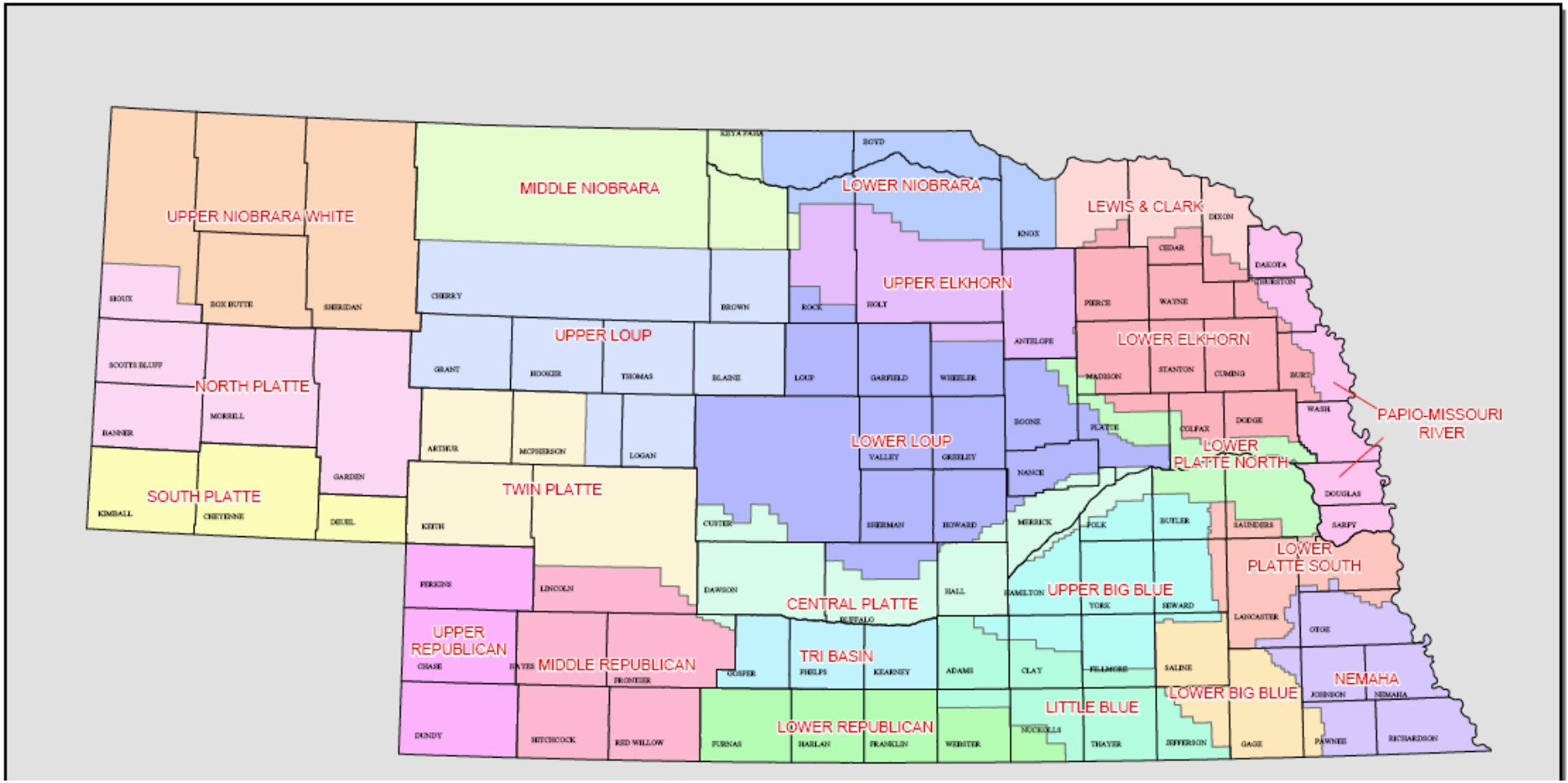
Miles
0 15 30 60 90 120

N W S

Data Bank

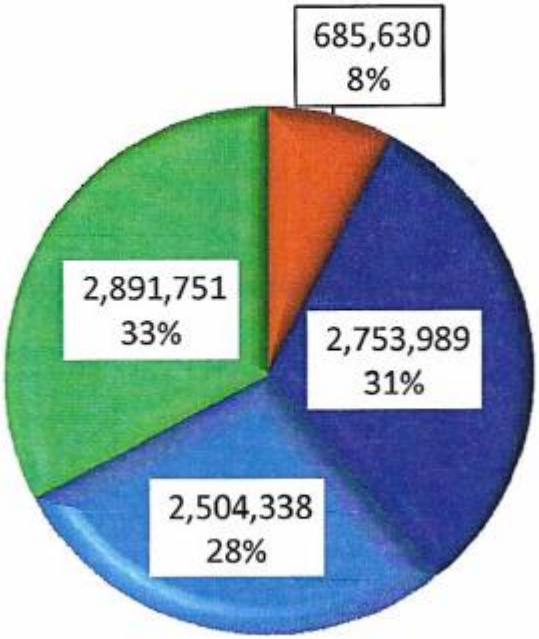
Information Source:
Produced by: Nebraska Department of Natural Resources
Topographic Data: TIGER Files, U.S. Bureau of Census 1992
NRC
GIS Process: ArcGIS 8.1
Processed: July, 2002 GF

Legend
County Boundary
NRD Boundary



GROUNDWATER IRRIGATED ACRES IN NEBRASKA - AUGUST 2011

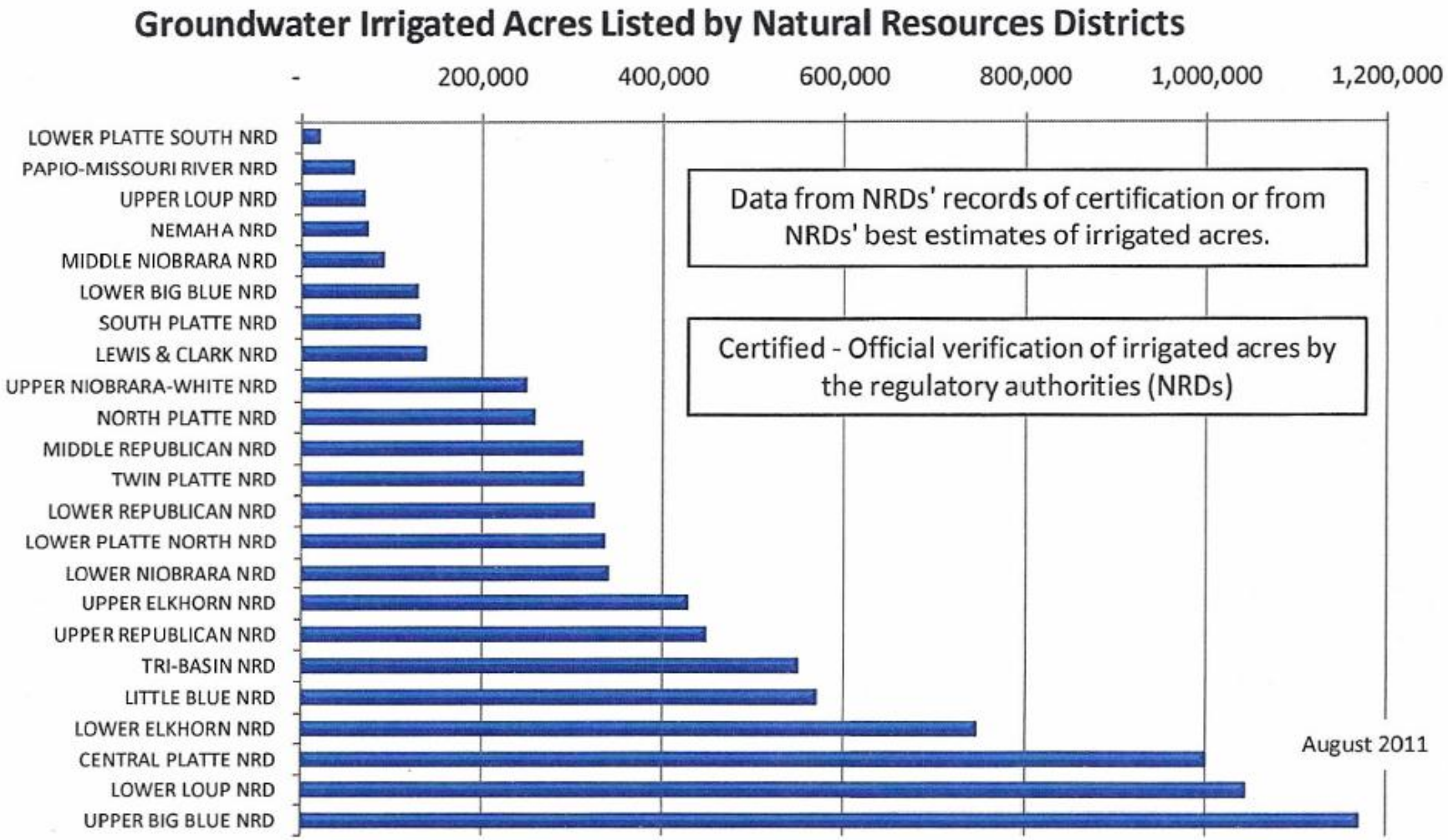
Groundwater Irrigated Acres
by Types of NRD and State Management and Regulation



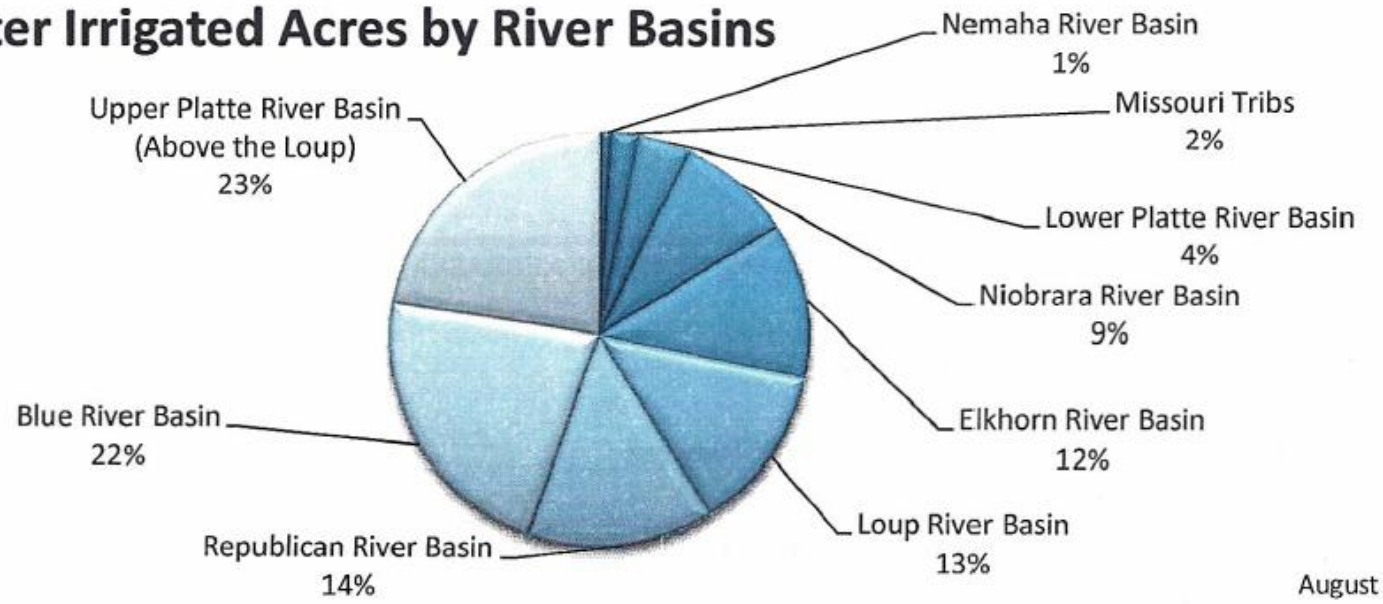
8,835,779 Groundwater Irrigated Acres in Nebraska

- Over Appropriated Area of Nebraska
- Fully Appropriated Areas of Nebraska
- Areas subject to LB483 irrigation growth restrictions
- Areas outside of LB483 irrigation growth restrictions

August 2011

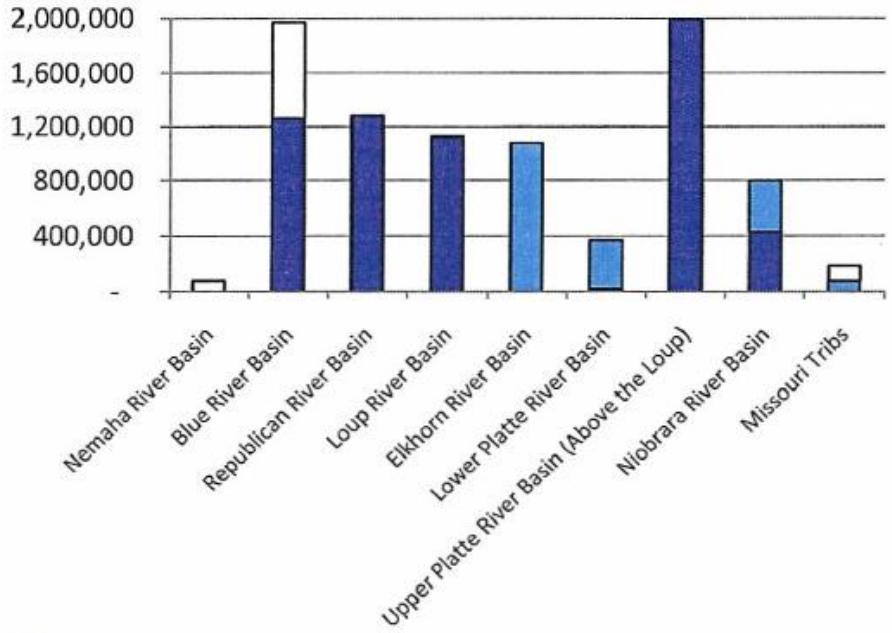

Groundwater Irrigated Acres Listed by Natural Resources Districts
-
200,000
400,000
600,000
800,000
1,000,000
1,200,000
LOWER PLATTE SOUTH NRD
PAPIO-MISSOURI RIVER NRD
UPPER LOUP NRD
NEMAHA NRD
MIDDLE NIOBRARA NRD
LOWER BIG BLUE NRD
SOUTH PLATTE NRD
LEWIS & CLARK NRD
UPPER NIOBRARA-WHITE NRD
NORTH PLATTE NRD
MIDDLE REPUBLICAN NRD
TWIN PLATTE NRD
LOWER REPUBLICAN NRD
LOWER PLATTE NORTH NRD
LOWER NIOBRARA NRD
UPPER ELKHORN NRD
UPPER REPUBLICAN NRD
TRI-BASIN NRD
LITTLE BLUE NRD
LOWER ELKHORN NRD
CENTRAL PLATTE NRD
LOWER LOUP NRD
UPPER BIG BLUE NRD
Data from NRDs' records of certification or from NRDs' best estimates of irrigated acres.
Certified - Official verification of irrigated acres by the regulatory authorities (NRDs)
August 2011

Groundwater Irrigated Acres by River Basins



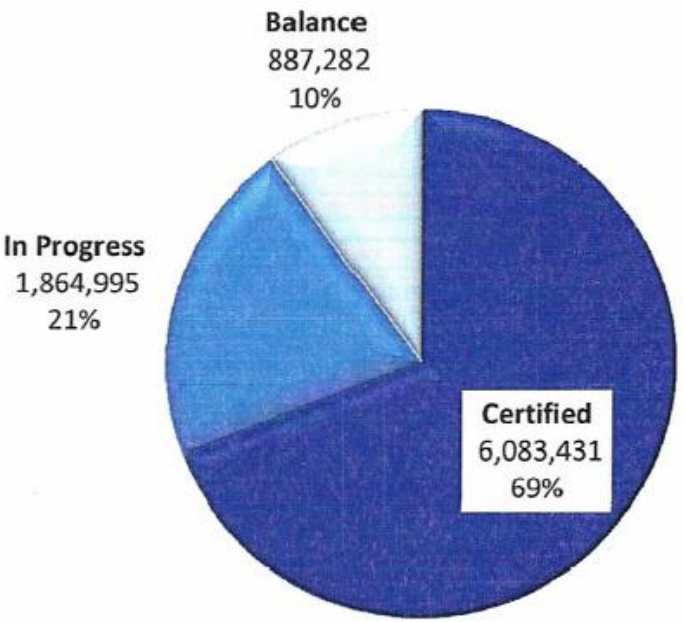
August 2011

Certified and Estimated Groundwater Irrigated Acres in Nebraska by River Basin



August 2011

Status of NRDs Certification of Groundwater Irrigated Acres in Nebraska



Certified - Official verification of irrigated acres by the regulatory authorities (NRDs)

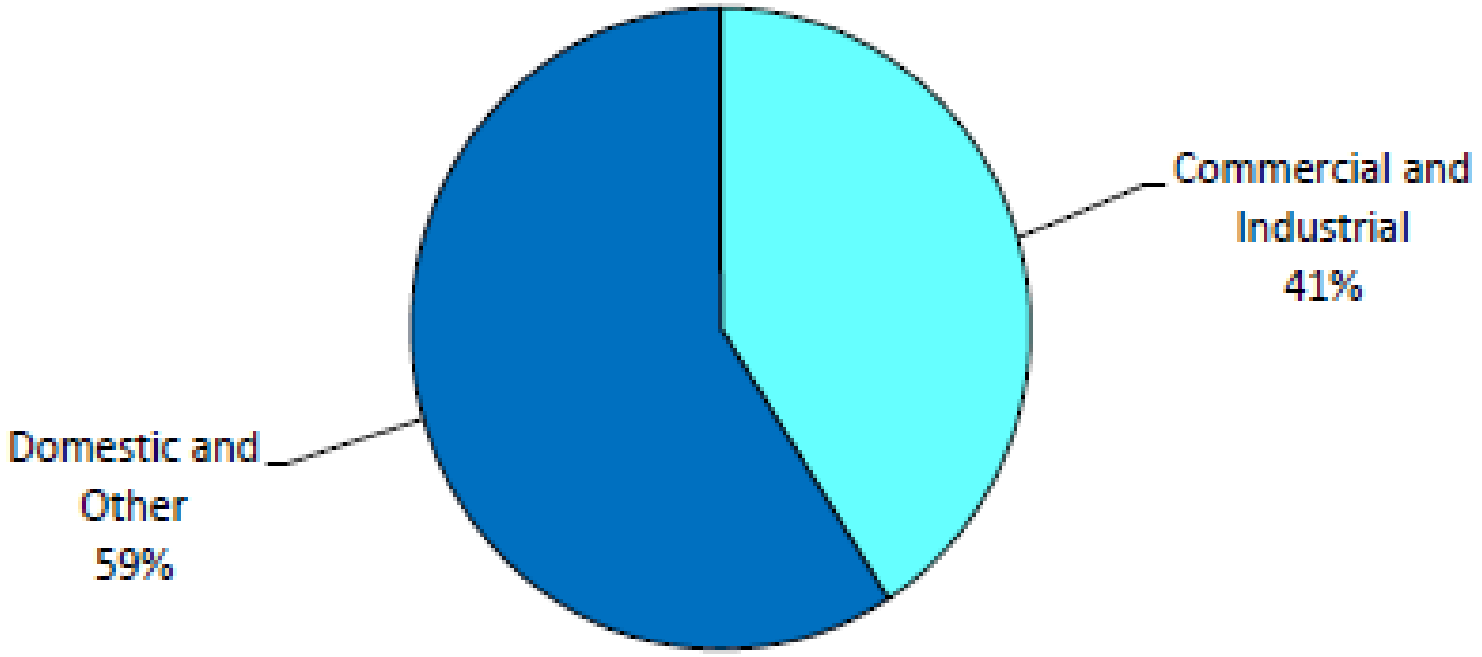
August 2011

Municipal Use

- 116 Communities Surveyed*
- Serving 1,200,873 people
- Commercial/industrial use varies by community
- Annual water use ~ 84,902,448,198 gallons
- Average per capita daily use ~ 193.7 gallons
- Wastewater discharge ~ 4,913,227,640 gallons

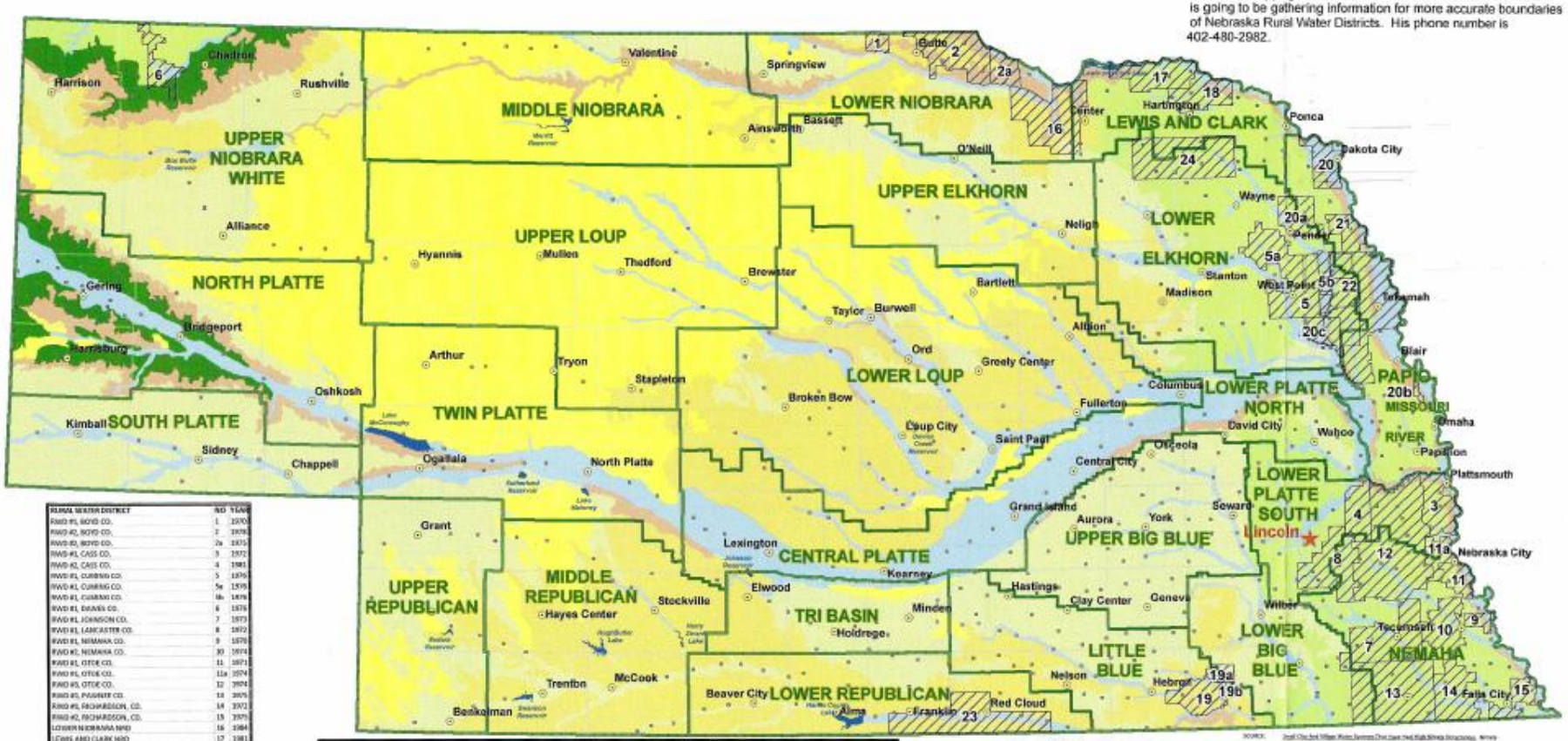
*Figures provided by the Nebraska League of Municipalities, from a survey representing 86% of the urban population.

Municipal Water Use - 10 Year Average



NEBRASKA RURAL WATER DISTRICTS

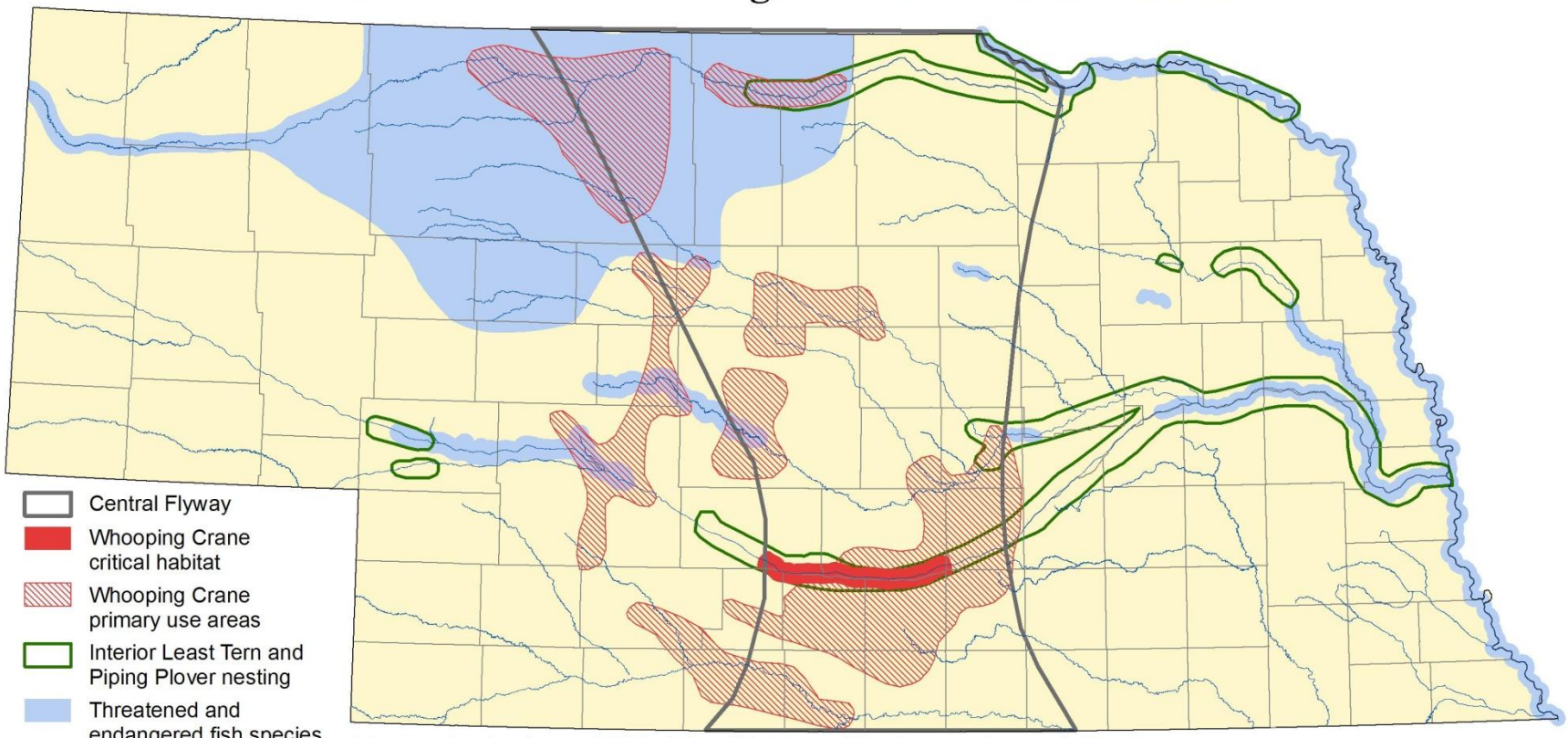
The information presented on these maps is the best available as of September 2011. The content and level of detail is based on available space and map scale. Charles Bausch, GIS/GPS Mapping from the Nebraska Rural Water Association is going to be gathering information for more accurate boundaries of Nebraska Rural Water Districts. His phone number is 402-480-2982.



RURAL WATER DISTRICT	NO	YEAR
RWD #1, BOYD CO.	1	1970
RWD #2, BOYD CO.	2	1978
RWD #2, BOYD CO.	2a	1975
RWD #1, CASS CO.	3	1972
RWD #2, CASS CO.	4	1981
RWD #1, CUMING CO.	5	1976
RWD #1, CUMING CO.	5a	1976
RWD #1, CUMING CO.	5b	1976
RWD #1, DAWES CO.	6	1976
RWD #1, JOHNSON CO.	7	1973
RWD #1, LANCASTER CO.	8	1972
RWD #1, NEMAHA CO.	9	1978
RWD #2, NEMAHA CO.	10	1974
RWD #1, OTOE CO.	11	1971
RWD #1, OTOE CO.	11a	1974
RWD #3, OTOE CO.	12	1974
RWD #1, PAWNEE CO.	13	1979
RWD #1, RICHARDSON, CO.	14	1972
RWD #2, RICHARDSON, CO.	15	1975
LOWER NIOBRARA NRD	16	1984
LEWIS AND CLARK NRD	17	1981
LEWIS AND CLARK NRD	18	1991
LITTLE BLUE NRD	19	1975
LITTLE BLUE NRD	19a	1978
LITTLE BLUE NRD	19b	1998
PAPIO-MISSOURI RIVER NRD DAKOTA CO.	20	1980
PAPIO-MISSOURI RIVER NRD THURSTON CO.	20a	1988
PAPIO-MISSOURI RIVER NRD WASHINGTON CO.	20b	1979
PAPIO-MISSOURI RIVER NRD	20c	1999
OMAHA INDIAN TRIBE	21	1992
LOGAN EAST RWD-LOWER ELKHORN NRD	22	1990
LOWER REPUBLICAN RWD #1	23	2005
RWD-COL WATER SYSTEM	24	2013

Lower Elkhorn
Natural Resources District
Protecting Lives,
Protecting Property, Protecting the Future

Threatened and Endangered Waterbirds and Fish



Threatened and endangered fish include pallid sturgeon, lake sturgeon, sturgeon chub, blacknose shiner, Topeka shiner, northern redbelly dace, and finescale dace.
Source: Nebraska Game and Parks Commission (www.ngpc.state.ne.us).

University of Nebraska Lincoln

This map was produced by the University of Nebraska-Lincoln.
For additional information and an interactive version of this map visit http:// water.unl.edu

The information presented on this map is the best available as of July 2008. To order a copy of this map go to nebraskamaps.unl.edu. Any questions or comments can be directed to the UNL Water Center at 402-472-3305 or

What does “beneficial uses” mean?

In Nebraska, all water appropriations must be for a beneficial or useful purpose.

Under statute 46-706, Terms, defined, it states:
"Beneficial use means that use by which water may be put to use to the benefit of humans or other species."

When a surface appropriator fails to use the water for the beneficial use specified in the permit for more than five years, the water right can be cancelled by the Department of Natural Resources.

46-204. Natural streams; priority of appropriations; first in time, first in right; preference from nature of use.

The right to divert unappropriated waters of every natural stream for beneficial use shall never be denied except when such denial is demanded by the public interest. Priority of appropriation shall give the better right as between those using the water for the same purposes, but when the waters of any natural stream are not sufficient for the use of all those desiring the use of the same, those using the water for domestic purposes shall have the preference over those claiming it for any other purpose, and those using the water for agricultural purposes shall have the preference over those using the same for manufacturing purposes.

46-613. Ground water; declaration of policy; preference in use.

Preference in the use of ground water shall be given to those using the water for domestic purposes. They shall have preference over those claiming it for any other purpose. Those using the water for agricultural purposes shall have the preference over those using the same for manufacturing or industrial purposes.

46-2,108. Appropriation of water for instream flows; terms, defined.

(1) For purposes of sections 46-1,107 to 46-2,119, unless the context otherwise requires:

(a) Department means the Department of Natural Resources.

(b) Director means the Director of Natural Resources; and

(c) Instream appropriation means the undiverted application of the waters of a natural stream within or bordering upon the state for recreation or fish and wildlife purposes.

(2) An instream appropriation may be obtained only by the Game and Parks Commission or a natural resources district and only for that amount of water necessary for recreation or fish and wildlife. The instream use of water for recreation or fish and wildlife shall be considered a beneficial use of water.

***Surface Water for "incidental recharge" of groundwater supplies is also recognized as a beneficial use in statute.**

What uses are not considered beneficial according to law?

- **A good question but the answer is not entirely clear, as there are differences between ground and surface water.**

- **Should they be harmonized?**

Can we identify water usage by each of the following groups?

- **Agriculture**
- **Commercial/Industrial**
- **Groundwater users**
- **Municipalities**
- **Public power**
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- **Surface water users**
- **Recreation**
- **Fish and Wildlife**
- **Rural**
- **Urban**

In what ways does the federal government regulate our water?

Generally, the state is the top dog in water rights within their state, EXCEPT:

- Federal funding for new water construction projects must adhere to Federal Standards and Principals, which now includes environmental issues.
- National Scenic Rivers and federal lands claim to have an implied surface water right that preserves the resources protected by Congress, also known as a Federal Reserved Water Right.
- The Endangered Species Act can have ramifications for state water use, especially on projects with a federal nexus.

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- On the Missouri River the US Army Corp of Engineers (USACE) regulates water for 8 authorized purposes via the Master Manual.
- USACE also has authority over draining, filling, or disturbances to wetlands and waterways.
- The Environmental Protection Agency (EPA) has authority over water quality through the Clean Water Act, which is administered by the NDEQ.
- The Bureau of Reclamation has some authority over projects that it controls.

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- Conflicts over interstate compacts/decrees may be settled in the U.S. Supreme Court.
- The Federal Energy Regulatory Commission (FERC) may exert authority through the licensing of hydro-power projects.
- The Nuclear Regulatory Commission (NRC) will look at impacts to aquatic wildlife in the relicensing of nuclear power plants.

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- **The Federal Water Pollution Control Act, commonly known as the Clean Water Act (CWA).**
- **Energy Independence and Security Act (EISA) requires federal agencies to execute strict storm water runoff requirements.**
- **Safe Drinking Water Act (SDWA) regulates public water systems.**
- **Underground Injection Control (UIC) protects underground sources of drinking water.**

- **Questions?**